Ernst Wildi

The HASSELBLAD Manual

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The Hasselblad is the most successful and versatile medium-format camera system in the world. These cameras are used by the world's leading photographers for every conceivable job, ranging from scientific, industrial, wildlife, expedition and underwater work to commercial, sport, fashion and press photography.

The book concentrates on the potential of the Hasselblad through its great range of lenses and accessories. A vast amount of information is presented to show not only the working and manipulation of the individual camera models but also to give an insight into ways in which these superb cameras and the ancillary equipment may best be applied in the many fields which demand results of the highest technical quality.

Apart from discussing the more usual applications of the Hasselblad system, the manual also covers a range of more specialized topics such as macrophotography and photomicrography, photography by ultra-violet, fluorescent and infra-red radiation, and from the TV screen.

The author's approach is that of the practising photographer. The meticulous detail of this work makes it a complete and comprehensive source of reference for all Hasselblad users. It is a true working photographer's handbook, with all the information necessary to operate the equipment and obtain the best results, from the most basic techniques to the most sophisticated, under conditions of actual work in various fields.

The Hasselblad Manual

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The Hasselblad Manual

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Introduction

Pride of ownership is one of the pleasures of working with Hasselblad. There are almost unlimited possibilities of changing the various components to make up your own 'personal' camera and then changing these to make up a different camera. When you use a Hasselblad you know that you are working with a tool that performs with the greatest precision and will continue to perform this way for many, many years. The greatest joy and pleasure, however, comes when you see the results—the sharpness of the large transparencies that makes them usable in an almost unlimited fashion for projection, presentations, wall decor or murals. This book is meant to help you use this technical quality to get the very best from your Hasselblad cameras, lenses and accessories and at the same time give you ideas to produce images which may be more interesting to look at, may be a little different from those you may have produced up to now and from those produced by other photographers.

Cameras can be used to record images that are as we see them with our eyes or to produce images that are completely different as only a camera can do. I feel that trying all the different capabilities of our equipment and experimenting with the cameras, lenses, and accessories, with the lighting arrangements and with the films in printing makes photography an even more stimulating hobby and profession than it is already.

ERNST WILDI
August 1980

I

The Medium Format

HASSELBLAD CAMERAS ARE of medium format, which has become popular because it combines many of the advantages of the small and the large cameras. Compact size and light weight, large film capacity and fast shooting capability (with motor drive if desired) are among the most important features in favour of 35 mm; the extent of automation, especially for exposure, and wide selection of accessories and lenses including lenses with extremely large apertures, are others. Large format cameras remain the only or best choice for the highest image quality, retouchability and the control of perspective and depth of field with swings, tilts and shifts. They also offer a wide selection of lenses with shutters and thus flash synchronization at all shutter speeds, and the possibility of using instant film material and changing from one film to another at any time.

The large/medium format naturally requires somewhat larger cameras than 35 mm, but they need not be much heavier. A Hasselblad 500C/M with standard 80 mm lens, for instance, weighs only a few ounces more than many professional 35 mm SLR models. All Hasselblad cameras can be operated as fast as 35 mm ones and motor drive operation is also available in the EL/M model. The range of lenses and accessories can rival the 35 mm cameras; shutter speeds now go up to 1/2000 sec on the 2000FC model; flash synchronization is available at shutter speeds up to 1/500 sec with between-the-lens shutters; and lens apertures are as fast as *f*2.

The medium format combines large film capacity (24 images with 220 film or 70 images with 70 mm perforated film) and a small film capacity (12 images on 120 film, or single images with cut film adapter). Instant picture material can be used, and with the Hasselblad magazine concept, the type of film can be changed at any time. The area of a $2\frac{1}{4}$ in square negative is about one quarter that of 4×5 in but it is also almost four times the size of 35 mm. Negative retouching is possible but limited.

Hasselblad users have the choice of three formats, $2\frac{1}{4}$ in square, $2\frac{1}{4} \times 1\frac{5}{8}$ in

and $1\frac{5}{8} \times 1\frac{5}{8}$ in, with a different film magazine for each size. Magazines permit rapid film changing either at the end of a roll or for using different emulsions. They also provide unlimited scope for multiple exposures. A partially exposed magazine may be stored for an indefinite period.

Medium format cameras have traditionally used one type of film only—120 roll film. Now 220 film allows twice the number of frames of the same size without enlarging the film spool and consequently the camera. Double-perforated 70 mm film, when spooled in 15 ft lengths into daylight loading cassettes, can be used in the Hasselblad magazine 70 and provides approximately 75 exposures. The Hasselblad also has a magazine which can take a 100 ft roll of 70 mm film to give approximately 500 exposures.

The 70 mm magazine also allows a greater choice of emulsions for special applications, such as orthochromatic, infrared or monochromatic, and recording films, films for high temperature processing, linagraph films for instrumentation work, and films for spectroscopic analysis. Sheet film is another possibility with Hasselblad, offering the most effective and, in many cases the only, way of evaluating the effectiveness of an image before recording it on the negative or transparency film.

While most medium format cameras use the same basic roll film size, the image areas recorded on these films are of different sizes or, in the case of Hasselblad, different image areas are obtained on the same camera with different film magazines.

The $2\frac{1}{4} \times 2\frac{3}{4}$ or 6×7 format

Image size: 55×70 mm; 10 images on one roll of 120 film.

The largest of the medium formats can be obtained only on cameras specifically made for this image size and not with $2\frac{1}{4}$ in square interchangeable film magazines. The larger image size requires a larger and heavier camera. Hasselblad have never considered this image area, producing instead lighter and more compact cameras for the slightly smaller square format. The cameras, film magazines and especially the lenses, however, are manufactured to a degree of precision that not only equals but perhaps betters the slightly larger negative.

The $4\frac{1}{2} \times 6$ format

Exact image size: 54×41 mm; 16 images on one roll of 120 film.

Promoted as a 'new' format, the $4\frac{1}{2} \times 6$ in has gained almost instant success because it corresponds to the popular 8×10 in paper and enlargements can be made without cropping. Some cameras are made specifically for this format. A special film magazine for this format (Magazine A16) is available for Hasselblad providing 16 images with perfect, even spacing. The long side of the $4\frac{1}{2} \times 6$ cm negative is the same as either side of the $2\frac{1}{4}$ in square. They are,

therefore, enlarged to the same degree for an enlargement in the 8×10 in proportions.

Superslide

Exact image size: 41×41 mm; 16 images on a roll of 120 film.

The Superslide format is more often associated with 35 mm than the medium format. The image area is two times larger than the 24×36 mm of 35 mm yet it can be projected on the readily available 35 mm machines. The square image is extremely effective. Superslide mounts are 2×2 in (same as regular 35 mm mounts) and the same slide tray or carrier can be used. Hasselblad offers a special magazine (A16S) for the superslide size. The image is completely surrounded by a black, unexposed film area. Cutting is easy and some laboratories will even return the superslides mounted for projection.

The $2\frac{1}{4}$ in square

Exact image size: 54×54 mm; 12 images on one roll of 120 film.

The $2\frac{1}{4} \times 2\frac{1}{4}$ in square format has put the medium format where it is today. Many good things can be said about the square:

The photographer has a wide choice in composing his subject, and he need not decide beforehand which way to turn the camera or the film-holder. Picture editors, artists, graphic production specialists love square prints or square transparencies because it gives them full freedom to crop to their specifications. The 12 images from a 120 roll of film fit beautifully on a sheet of 8×10 in paper and since the camera is always held the same way, all shots appear the right way up.

Square slides projected on a square screen fill the entire screen and give a much stronger impression of 'being there' instead of looking at an image. The $2\frac{1}{4}$ in square is given on Magazine A12, A24, the sheetfilm adapter and the 70 mm and Polaroid magazines.

2

Hasselblad Cameras

IN *1948* THE HASSELBLAD 1600F was unveiled: the world's first $2\frac{1}{4}$ in single-lens reflex camera with interchangeable lenses and film magazines. In *1952* the 1600F was superseded by the 1000F, which was identical in design but with shutter speeds up to 1/1000 sec only, instead of 1/1600 sec which gave the first camera its model number. The *1954 Photokina* in Cologne was used to introduce the Hasselblad Superwide with a fixed 38 mm *f*4.5 Zeiss Boigon lens mounted in a Compur shutter.

1957 saw the next major step in the history of Hasselblad when the 500C model replaced the 1000F. The proven basic camera design was kept, but in place of the focal-plane shutter, a Compur shutter was built into each lens to allow electronic flash to be used at all speeds. The 500C was introduced with four lenses: 60 mm, 80 mm, 150 mm and 250 mm.

The next few years in Hasselblad's camera history read as follows:

1959 Introduction of a modernized version of the Superwide—the Superwide C.

1965 The motor-driven model, the 500EL, appears. The 500EL design formed the basis for the 500EL Data camera specially produced for NASA and which, on July 20 1969, became the first still camera used on the surface of the moon. The 500EL kept the basic design of the 500C to allow interchangeability of lenses, viewfinders, film magazines. 1965 was also the year when Hasselblad started the publication of the Hasselblad magazine in five languages.

1970 The 500C and EL models were modified to include interchangeability of ground-glass screens. The new models became known as the 500C/M and 500EL/M.

1971 A special Hasselblad camera, the MK 70, was introduced. The MK 70 has the design of the Data camera used by NASA with reseau plate and magazine 70. Its application is in the field of photogrammetry.

1972 Black versions of the 500C and EL models were added.

1977 The 2000FC camera was introduced as an addition, with a 1/2000 sec

shutter speed which can only be obtained with the focal-plane type. Four lenses were introduced with the camera: the Planar 80 mm f2.8, the 50 mm f2.8, 110 mm f2, and the 150 mm f2.8.
1980 saw the introduction of a modified Superwide C, the SWC/M, which now takes Polaroid magazines.

As many features and operations as possible are identical in all Hasselblad cameras. The rear of the camera body is designed so that magazines can be switched from one camera to another at the end or in the middle of a roll of film. Consequently, all camera models can be used with 120 roll film, 220 roll film, 70 mm film, Polaroid material and sheet film. All camera models also can produce $2\frac{1}{4} \times 2\frac{1}{4}$ in square images, $4\frac{1}{2} \times 6$ cm rectangles or Superslides, by changing magazines. The film magazine interchangeability includes even the original 1000F and 1600F models as the rear of the camera was not changed. The very early magazines with serial numbers below 20 000, however, are usable only on the 1000F and 1600F cameras.

The lens mount was changed in 1957 so lenses from the original models cannot be used on the newer types and vice versa. All models made since 1957, the 500C-C/M, 500EL-EL/M and 2000FC models, are made for, or usable with, the same Compur shutter lenses with flash synchronization up to 1/500 sec.

The bottom of all camera models is identical so that they can all be mounted on tripods or stands by means of the tripod coupling, but here the conformity stops. Each model is built and designed to be best suited for the particular application for which it is made; one major difference is in the shutter.

Focal-plane shutter

The Hasselblad 2000FC has a focal-plane shutter consisting of two titanium curtains, which are only 0.014 mm thick. Between pictures, the curtains cover the film completely so that the lens can be changed at any time. At rest, when cocked, the curtains are slightly separated. If the shutter speed is set at 1/2000 sec, both curtains start moving the moment the release is depressed. When the shutter speed is set slower than 1/2000 sec, only the first curtain moves when the release is depressed; the second curtain moves later. The time of delay is determined by the shutter speed, and controlled electronically. The actual movement of the curtain is mechanical but, compared to a lens shutter, fewer mechanical components are involved, especially those that require lubrication.

Since a focal-plane shutter scans the film area from side to side, different areas of the film are exposed to light at different times. This means that when flash is used, the flash must go off when the shutter is open over the entire film area, otherwise only part of the film area is exposed. This never happens at high shutter speeds and, consequently, flash pictures can be made only at

slower speeds. On the 2000FC, the range is from 1 sec to 1/90 sec. To make the 2000FC user aware of this limitation, the flash does not fire when the camera is set at speeds above 1/90 sec.

When photographing a subject moving horizontally in front of the lens, it may be recorded physically longer than in reality if the image crosses on the film in the same direction as the curtain, or physically shorter when it moves in the opposite direction. In either case, it is referred to and recognized on the film as a form of distortion.

Lens shutter

The other type of shutter is in the lens. Shutter blades open and close at the set speed, exposing the entire film area at the same time and for the same length of time. With lens shutters, distortion of moving subjects does not occur and flash pictures can be made at all speeds.

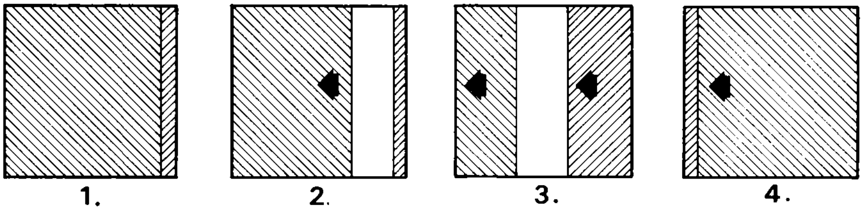
Because the lens shutter is next to the lens diaphragm, it opens and closes in front of a large opening when the diaphragm is set to large apertures, and in front of a small opening when the diaphragm is closed down. The engraved shutter speeds are calibrated as if the blades opened fully and closed again; in other words, they are calibrated for a larger aperture. When the lens is closed down, the small aperture is uncovered slightly sooner and covered slightly later. The effective shutter speed may be longer by the equivalent of 1/2 or even one *f* stop. On a properly lubricated lens, this happens only at 1/500 sec and only when the diaphragm is completely, or almost completely, closed down. It also depends on the diameter of the shutter. Keep this in mind and compensate for it to avoid slight overexposure.

All Hasselblad C lenses have built-in shutters. Opening and closing of the lens shutter blades is the smoothest and quietest shutter operation but the maximum shutter speed is limited—in the Hasselblad lenses to 1/500 sec. Shutter operation is completely mechanical, and, as most lubricants work differently at different temperatures, the lens shutter operation is therefore affected by temperature, especially cold temperatures. The shutter slows down when exposed to extremes, especially when lubricants are old. To assure accuracy in shutter speed and operation, Hasselblad shutter lenses should be cleaned and lubricated at regular intervals depending upon use.

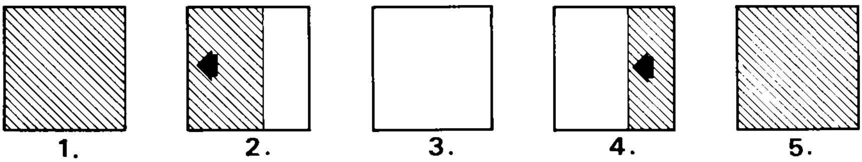
Hasselblad 500C/M and 500EL/M

The 500C/M and 500EL/M models are identical in the interchangeability of components, the viewing methods and the possibilities in the use and operation of lenses and magazines.

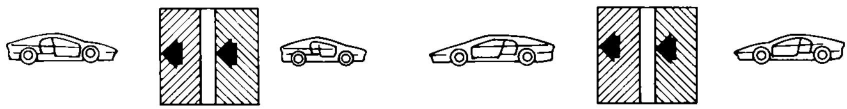
Both are single-lens reflex models with the mirror returning into the viewing position when the film is advanced. Neither camera contains a shutter. A rear curtain protects the film from light while viewing and lens changing.



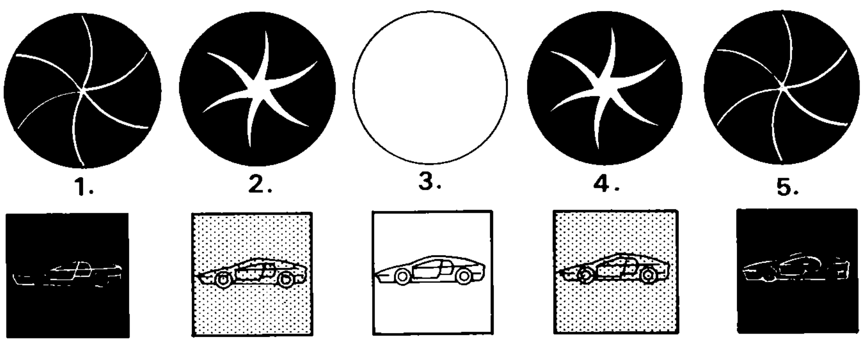
When the focal-plane shutter is used, the film is exposed progressively by a slit which moves across the image area. **1.** The shutter curtains are closed. **2.** The first shutter curtain moves creating a slit which begins the exposure. **3.** The second shutter curtain follows the first. **4.** The shutter is closed.



On the 2000FC at shutter speeds of 1/90 sec or longer, the second shutter curtain begins to move only after the first has reached the other side. There is therefore a point at which the entire image area is uncovered (**3**) and flash synchronization is possible.



Focal plane shutters can distort images of moving subjects because the recording of the image is progressive rather than instantaneous. Thus an object moving in the same direction as the shutters will appear elongated; one moving in the opposite direction will appear shortened.



When the lens shutter is used, the entire film area is exposed immediately. During the cycle the image becomes bright and then darkens again.

On the 500C/M, film is advanced and the shutter is cocked manually by a single turn on a knob or crank. On the 500EL/M, this is done automatically with an electric motor permanently attached to the camera and powered with rechargeable NiCad batteries, also in the camera body. The battery and motor compartment makes the camera 43 mm ($1\frac{3}{4}$ in) taller and 470 g ($16\frac{1}{2}$ oz) heavier.

The advantage of motorized film transport

Camera operation, which is now reduced to pressing the release when using motordrive, can be done with one hand. This is useful when the other may have to be used for holding on, holding a flash or other accessory, directing or shading the lens or eyes. Automatic electric film advance is smooth, with little danger that a mounted camera will move out of position between shots.

Sequence operation, i.e. shooting pictures continuously on a single pressure of the shutter release, is another reason for motorized cameras. Its applications depend on the speed capability, i.e. at what speed pictures can be taken. The Hasselblad's maximum is around 12 frames in 9 sec, a little more than one image per second, which is somewhat limited for a sequence camera in sports photography, but sufficient for sequence shots in most other fields.

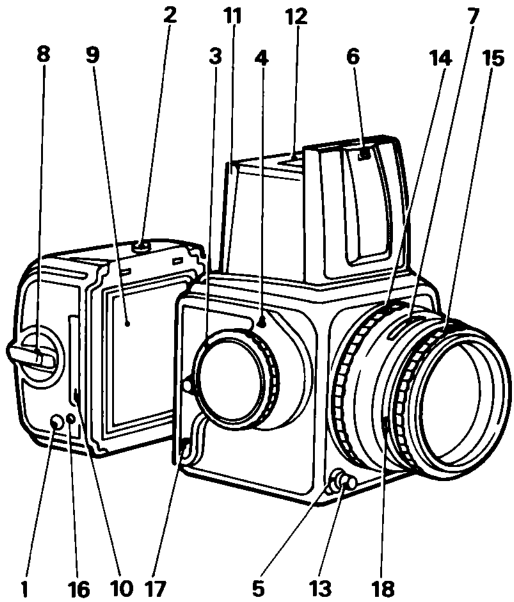
More important than sequence operation, however, is the fact that the motorized camera is always ready for shooting a moment after a picture is made. When photographing people, especially children, the best expression often appears just after the picture was snapped, perhaps as a sign of relief. This expression lasts for a moment only, never long enough to capture it with manual film advance, but long enough for a second push on the release of the EL.

Directing is important when photographing people. While this can be done from behind the camera, it is often easier closer to the subject. A motordrive makes this easy: simple extension cords allow remote operation, and you only need return to the camera for changing film, lens settings, etc. While taking the pictures, you can be close to the people, watch their expressions, direct, play with a child, and snap the shutter when everything is right.

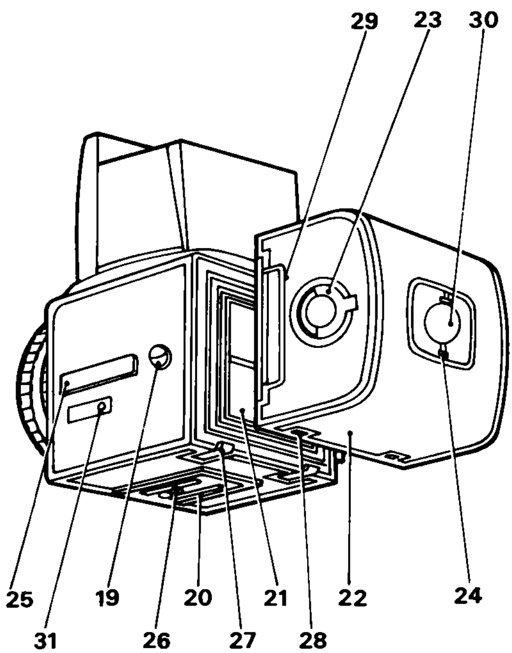
Remote camera operation is also both useful and necessary when it is dangerous or impossible to be near the camera. Instead of cords, the camera can be triggered with radio waves (a wonderful possibility in wildlife photography), by an intervalometer when the pictures are to be taken at regular intervals (time lapse), or by any other triggering source, e.g. electricity, light or sound.

Multiple camera operation is also made possible by motordrive. To take two or more images simultaneously, on different film, from different angles, or with different lenses, two or more motordrives are connected to one release, or the Hasselblad command unit. It is as simple as that.

The Hasselblad 500C and 500C/M



1 Frame counter of film magazine.
2 Magazine latch.
3 Winding knob.
4 Locating mark for winding knob.
5 Cable release socket in button (13).
6 Release for focusing hood and for magnifier.
7 Depth of field indicator.
8 Winding crank of magazine.
9 Magazine slide.
10 Focal plane mark.
11 Folding focusing hood.
12 Magnifier.
13 Shutter release with time exposure lock.
14 Focusing mount of standard lens.
15 Shutter speed ring.
16 Transport signal of magazine.
17 Transport signal on camera body.
18 Exposure value and aperture setting lever.
19 Carrying strap fitting.
20 Baseplate for quick tripod coupling.
21 Auxiliary shutter.
22 Film magazine.
23 Locking key of magazine.
24 Film speed indicator.
25 Accessory rail for sports finder and spirit level.
26 Tripod sockets.
27 Hooks for magazine engagement.
28 Recesses for magazine engagement.
29 Handle of magazine slide.
30 Film type indicator.
31 Fitting for cable hook.



The Hasselblad 500C and 500EL

The 500C and 500EL (prior to 1970) are identical to the 500C/M and 500EL/M in both design and features, with the exception that they do not have the interchangeable ground-glass screens, although the screens can be changed by a Hasselblad Service Centre.

Since the older and newer versions are identical in practically all other respects, everything about the 500C/M and 500EL/M described in the text applies equally to the 500C and 500EL models. The engravings on the camera bodies were not changed from 500C to C/M or from 500EL to EL/M immediately the change took place. For some time, 500C/M and 500EL/M models were produced with 500C and 500EL engravings. To verify whether your 500C and 500EL might be a 500C/M or 500EL/M model, remove the viewfinder and check whether the camera has the two ground-glass retaining clips described in the viewing and focusing section.

Hasselblad 2000FC

The Hasselblad 2000FC has the same single-lens reflex concept but allows the photographer to control the mirror operation. The mirror can be made to return when the film is advanced, as on the 500C/M and EL/M, or to return instantly when the release is depressed. Alternatively, it can be set to operate in the same way as the 500C/M, or be locked up, so that it never moves into the path between the lens and film.

Instead of the rear curtain, the 2000FC has an electronically controlled focal-plane shutter with speeds from 1 sec to 1/2000 sec plus B. The power for the electronics is supplied by a 6V battery in the camera body. The 2000FC can only be operated through the electronic circuit; it does not work if the battery is dead or removed. The focal-plane shutter is made from titanium only 0.014 mm thick and can easily be damaged when the magazine is off the camera. *Extreme care is necessary.*

The normal shutter speed range is 1–1/2000 sec, with electronic flash synchronized up to 1/90 sec. All shutter speeds can be made 60 times longer by an accessory shutter speed multiplier.

With a shutter in the camera, the lenses do not need one, so lenses are especially designed for this camera. They have closer focusing performance than their equivalents with shutters, a different arrangement and design of the controls, and, in some cases, they also have larger apertures. It is likely that more non-shutter lenses with new capabilities, for instance macro or shifting elements, will appear on the market. In addition, the shutter in the camera simplifies the adaptation and use of other lenses, including the Luminars. It also simplifies photography where camera lenses are not used, such as photomicrography and astrophotography. Lenses for the 1000F and 1600F do not fit the 2000FC.

With the lens mount identical to the 500C/M and EL/M, all Compur shutter lenses can also be used. Either the camera shutter or the lens shutter can be used.

Film advance and shutter cocking is manual with a winding crank. The film advance, however, can be disconnected, so you can make double and multiple exposures without removing the film magazines. When registration of the two or more superimposed images is necessary, the 2000FC must be considered essential, because removing and replacing the magazine may well move a 500C/M or 500EL/M.

The Hasselblad Superwide

The Biogon 38 mm *f*4.5 lens, with a 90° diagonal angle of view when used for the $2\frac{1}{4}$ in square, is designed like all other Hasselblad shutter lenses with shutter speeds and flash synchronization up to 1/500 sec. However, it is fixed to a short camera body without reflex viewing. As a non-reflex camera the Superwide does not require the rear curtain of the SLR models.

An optical viewfinder attaches to the top of the camera. Focusing is achieved by estimating the distance. You can view and focus the image, however, on a ground-glass screen by detaching the film magazine and adding the ground-glass back adapter to the camera body. From a viewing and focusing point of view, the Superwide is then like a wide-angle view camera. The ground-glass adapter and finder must be removed before the film magazine can be attached.

Accurate horizontal alignment of the camera, important in architectural and advertising photography, is assured by a built-in spirit level.

The SWC/M takes all the film magazines of the 500C/EL/2000FC models. The use of the Polaroid magazine requires a minor modification to the SWC body, which can be done by a Hasselblad agent. The Superwide is a small and light medium-format camera, which is one reason why you might want to select it instead of the 40 mm Distagon, which gives nearly the same area coverage when used on the 500C/EL or 2000FC.

The small size of the 38 mm Biogon permits the use of the relatively small 63 mm Hasselblad filters and standard series VIII filters and lens attachments made by other companies. You can also attach the professional sunshade and use 3 in square gelatin filters. The 38 mm Biogon has a completely different optical design compared to the 40 mm Distagon. It is an optically true wide-angle lens which provides a distortion-free image with superb corner quality in both close-ups and distance shots.

The original Superwide was also equipped with a Biogon 38 mm *f*4.5 lens. The rear was identical and took the same film magazines. The operation differed mainly in two respects: the film was advanced with a knob, not a crank, and the shutter required separate cocking.

The Hasselblad MK 70

The MK 70 is a motor-driven Hasselblad camera designed for photogrammetric applications. It is similar to the Data camera used in the space program and based on the standard 500EL design but without mirror and ground-glass focusing. Consequently, the MK 70 does not have the prerelease settings, S, SR and AS; the operating dial is limited to O and A settings. A focusing-screen adapter, especially made for the MK 70, can be attached to the camera after removing the film magazine.

The MK 70 is fitted with a reseau glass plate, 0.08 mm in front of the film plane. Vacuum evaporated on the plate are 25 cross-shaped index marks, 10 mm apart, which are recorded on the film and are used when measurements are made from the images. Because of the reseau plate, special film magazines must be used. A MK 70 magazine is made for the same daylight loading cassettes of 70 mm type II perforated film which are used in the regular magazine 70. Another of the same size is a darkroom loading type with spools for 165–185 exposures per roll of thin base film, the number of exposures depending on the thickness of the film.

While all Hasselblad shutter lenses can be mounted on the camera, the lenses used for photogrammetric purposes must be calibrated to the camera. Two lenses are recommended and especially made for this purpose: the 60 mm *f*5.6 MK Biogon with focusing down to 0.9 m (35 in) and the 100 mm *f*3.5 MK Planar with the focusing ring locked at infinity.

The MK 70 is driven by the EL batteries and takes EL accessories like the intervalometer, radio release, connecting cords and command unit.

3

Interchangeability

Removing the lens

All Hasselblad cameras with interchangeable lenses made since 1957 have identical rugged steel, bayonet lens mounts. Lenses can only be removed and attached when the shutter is cocked and the camera is ready to be released, but not prereleased, i.e. the lens shutter is closed.

If the signal in the camera body is red, the film has not been advanced. Turning the winding knob or crank on the 500C/M or 2000FC should solve the problem. If you do not want to advance the film, remove the magazine, then turn the knob or crank and reattach the magazine. If the signal in the camera is white but the knob or crank cannot be turned, the camera is in the prereleased mode. To bring the 500C/M into the normal position, remove the magazine, press the camera release, turn the winding knob or crank and reattach the magazine. When the EL/M is prereleased, the operating control is probably set to SR or AS; if so, remove the magazine, set the operating lever on O and press the release which brings the camera automatically into the normal position. Since the 2000FC allows shutter cocking without advancing the film, you need not remove the magazine. Simply turn the winding crank while depressing the centre button as for a double exposure.

To take the lens off, press the lens lock lever, turn the lens about 60° counter-clockwise and lift it out.

Attaching lenses

To attach a lens to a 500C/M, 500EL/M or 2000FC body, it is not necessary to depress the lens lock lever. Simply place the lens into the mount and turn it until there is a definite click, which indicates a complete and secure combination of body and lens. Lenses can be attached to the camera body only if the camera is ready for shooting and the shutter in the lens is cocked. The ridge on the camera's connecting shaft should point to the red dot; if it does not, reset the camera as for removing the lens.

The shutter in any C lens is normally in the cocked position as this is the way lenses are removed from the cameras. The shutter is open and the slot in the lens coupling shaft is also lined up with the red dot. If it is closed and the slot is not lined up, cock the shutter by turning the shaft clockwise with a coin until it clicks in position. Never use a screwdriver for this purpose: it may slip off and end up on the surface of the rear element.

As the Hasselblad extension tubes and the automatic extension bellows have the same mounting arrangement, everything that has been said about removing and attaching lenses also applies to these accessories. If components do not remove or attach easily and instantly, something is probably wrong somewhere, so check. Never use force.

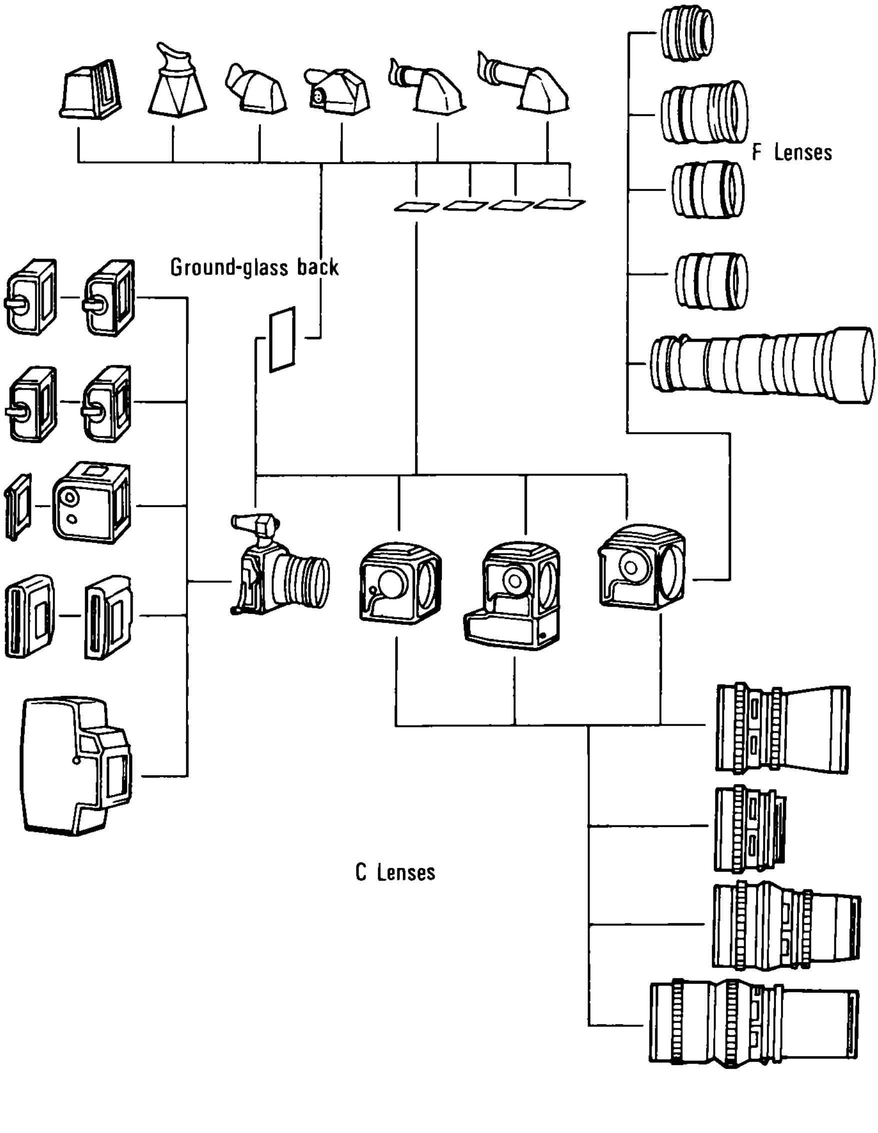
To avoid possible damage to the focusing or aperture/shutter mechanisms in the lenses, always hold a nonmovable part when removing or attaching them. The 2000FC lenses, without shutter, have a special knurled ring for this purpose, which is the narrow ring with index between the movable focusing and aperture rings. The long-focus lenses, with shutter from 120 to 500 mm, are held at the rear where most lenses (except the 500 mm and Variogon zoom) also have a special, nonmovable, knurled ring. The wide-angle lenses from 30 mm to 60 mm should be held at the large nonmovable front section. The small 80 and 100 mm Planar lenses are changed most easily by placing the hand over the entire lens.

Removing film magazines

Hasselblad film magazines can be removed from the camera bodies whether they are loaded with film or not, or whether the film has been advanced. They can be removed, however, only when the darkslide is inserted, more than halfway on the newer automatic types. The reason for this is easy to understand: the moment a film magazine is removed from the camera, the film is exposed to light and ruined. The purpose of the darkslide is to keep the film magazine completely light tight when it is removed from the camera. On the camera, the camera body with its auxiliary or focal-plane shutter keeps the magazine light tight.

On the 500C/M and 2000FC, there is another reason for inserting a darkslide and that is to prevent accidental releasing of the camera. As long as a darkslide is in the magazine, the camera release cannot be depressed. The same applies to the 500EL/M, but here the release can also be locked by setting the lock and charging lever on the motor compartment to L, which is easier and quicker than inserting a darkslide.

To remove a magazine, push the magazine lock on top of the magazine to the right. All cameras can be operated with magazines removed. Keep in mind that the titanium focal-plane shutter of the 2000FC camera can be easily damaged by a magazine, finger or other object. Be very careful when the magazine is off. Never place the 2000FC without a magazine in a camera



Interchangeability within the Hasselblad system
With the exception that the Polaroid magazine 80 cannot be fitted to the 2000FC, all Hasselblad cameras can accept all the Hasselblad magazines. The 500C/M, 500EL/M and 2000FC models take the same Compur lens with shutter, the same ground-glass screens and the same viewfinders. All the finders can be used with the Superwide in combination with the ground-glass back. The 2000FC can also be used with non-shutter F lenses.

case, in a gadget bag or leave it anywhere unprotected. If it must be stored or placed somewhere, protect the rear of the camera with the rear protective cover. This precaution is not so necessary with the other models where the rear curtain is not as delicate.

Attaching the film magazine

Before a magazine is attached to the camera, determine whether the camera is in the ready position (signal white) and whether the film in the magazine has been advanced (signal in magazine also white). If so, attach the magazine by hooking the two lower support catches onto the camera body and pivoting the upper part of the magazine towards the camera body until it locks in position; remove the darkslide and the camera is ready for the next shot.

If you attach a magazine with film advanced (signal white) to a body that is not in the ready position (signal red), you will waste a frame as the necessary shutter cocking will again advance the film. To avoid this, lift the magazine off again while turning the winding knob or, on the 2000FC, turn the winding crank while depressing the slotted disc.

If the film has not been advanced (signal in magazine red), attach the magazine to a camera body that also has a red signal (shutter has not been cocked). Now, turn the winding knob or crank, which cocks the shutter and advances the film (making both signals white), remove the darkslide and the camera is ready for the next shot. There is one exception to this case viz. when making double exposures. The second exposure is made without the film having been advanced, i.e. the magazine with a red signal is attached to a camera body with a white signal.

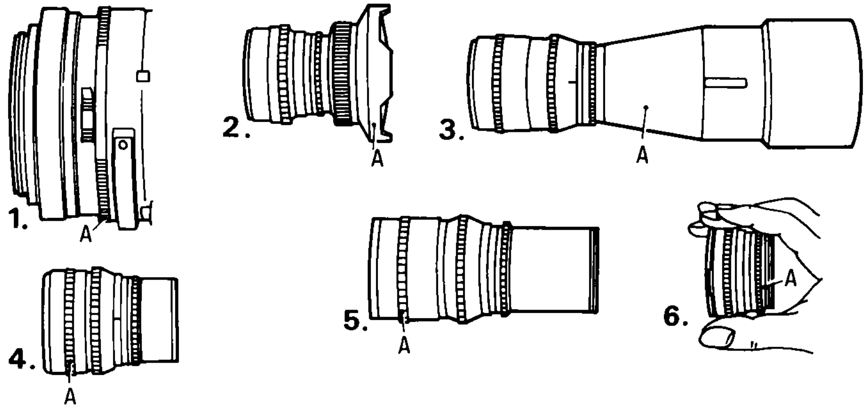
Magazines for Polaroid film

Polaroid film 'transport' is not in any way connected to the camera's mechanism. The camera's winding crank or knob can be turned without affecting the Polaroid film magazine. Also, because the NC-2 viewfinder and prism viewfinder with exposure meter extend beyond the rear of the camera body, the Polaroid magazine, which protrudes over the top of the camera body, cannot be fitted. These viewfinders should, therefore, be replaced by one of the other types before the Polaroid backs are attached. The latest NC-2 type has been reshaped for use with the Polaroid magazine.

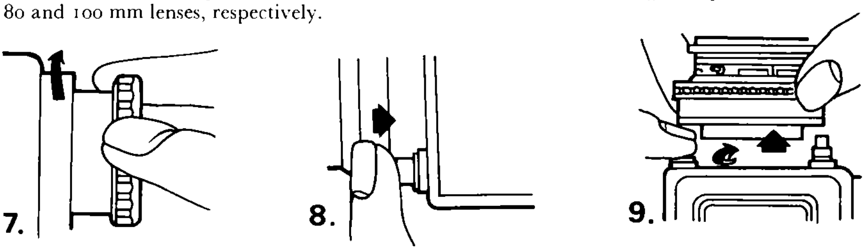
Polaroid magazines 80 and 100 can be used on all models except the 2000FC. The shutter of that camera will be damaged by the glass corrector plate of the magazine 80, so never try to use this combination. The magazine 100 can be fitted to the 2000FC with no problem.

Polaroid film magazines on Superwide cameras

On Superwide cameras up to 1980, neither Polaroid magazine is usable because the tripod plate which protrudes beyond the rear of the camera

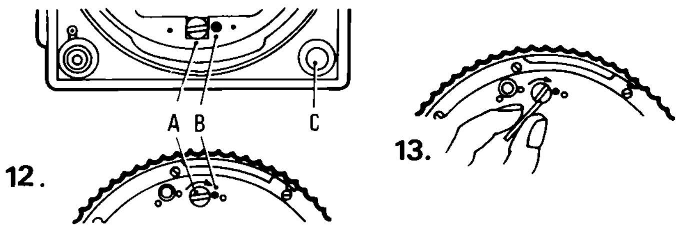


When attaching or removing lenses, hold them by a non-movable part, e.g. the positions marked 'A' in figures **1**–**6**, which represent the 2000FC lenses without shutter, 30–60 mm wide-angle lenses with shutter, telephotos from 250–500 mm, 120–150 mm lenses, longer telephotos, and small 80 and 100 mm lenses, respectively.



When removing a lens (**7**, **8** and **9**), check that the winding knob has been turned, depress the lens lock button, and turn the lens counter-clockwise one fifth of a turn (as seen from the front).

To attach a lens (**10** and **11**), insert the lens in the bayonet mount so that the red marking on the lens mount is aligned with that on the camera. Rotate the lens clockwise until it clicks into place.



Lenses can only be attached to the camera if the slot or ridge on the coupling shafts (A) are lined up with the red dots (B) on the camera body and lens (**12**). If the camera slot is not lined up, turn the winding knob or, on the EL/M, change from the prereleased to normal position. If the lens shutter is uncocked and the slot not lined up with the dot, insert a coin in the slot and make one full clockwise turn (**13**).

body is slightly too high to let the bottom of the magazine drop into the two lower support catches of the camera. Also, the Superwide's winding crank protrudes beyond the rear of the camera body, preventing the magazine being pushed against the camera body. Both problems can easily be overcome by shimming the tripod plate and shaving the crank. These modifications are available at Hasselblad service centres. The SWC/M cameras introduced in 1980 have included the necessary shimming and a different winding crank to allow full use of the magazines.

Attaching and removing viewfinders

All the viewfinders are interchangeable between all SLR models, including the 1000F and 1600F. After detaching the film magazine, slide the viewfinder towards the rear. Slide in the new viewfinder from the rear and replace the magazine.

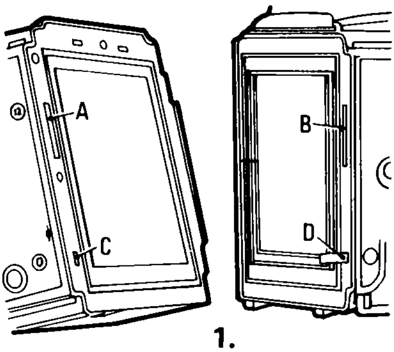
Changing ground-glass screens

On the Hasselblad 2000FC and the 500C/M and 500EL/M models, focusing screens can be changed easily and at any time, after removing the film magazine and the viewfinder. When doing so, hold the screens only by their edges as they can be scratched easily and are difficult to clean. The focusing screens and the opening in the camera are perfectly square, so the screens can be inserted either vertically or horizontally. For example, the screen with split-image rangefinder can be placed on the camera so that the dividing line is either horizontal or vertical. The screen must, however, be inserted the right way up to provide the correct plane of focus. The finished side which has a metal frame over the screen, making it look like a picture frame, goes on top.

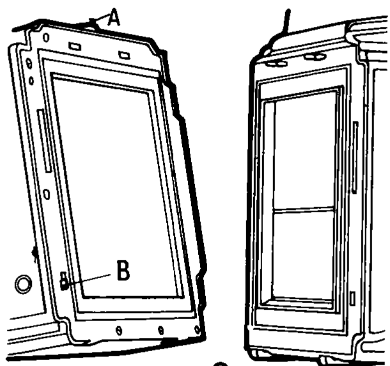
Changing the winding knobs

The 2000FC and the Superwide cameras have built in nonremovable film winding cranks. On the 500C/M, the winding knob is removable so that it can be changed for a winding crank or knob with exposure meter. The knobs or cranks are best removed and attached when the camera is in the cocked position as the winding mechanism does not then rotate. If it cannot be turned, remove the knob by pushing the locking device on the knob or crank away from the camera, while simultaneously turning the knob or crank counter-clockwise.

The accessory knobs or cranks are supplied in a plastic case with an identical locking device and are removed from the bottom plate of the case in the same way as they are removed from the camera. To attach the knob or crank to the camera, press it against the camera so the open circle is opposite the triangular index. They are locked into position as soon as the solid circle is opposite the index.

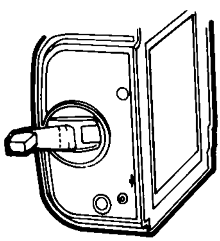


1.

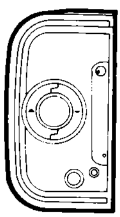


2.

1. At the upper left of the front plate of all magazines is a gear (A) that connects to the winding mechanism (B) of the camera. At the lower left is an opening (C) for the pin (D) that comes out of the camera when the darkslide is completely or at least halfway pulled out and the release depressed. When the darkslide is inserted, a piece of white metal (**2**B) covers half the opening so that the pin cannot penetrate and the release cannot be depressed. The magazine lock button (**2**A) can only be pushed far enough sideways to lift the magazine off of the camera when the darkslide is fully inserted.



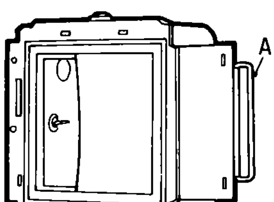
3.



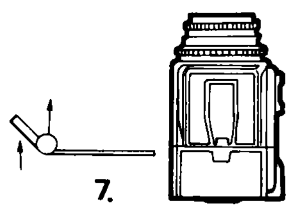
4.

5.

Automatic and non-automatic magazines can be distinguished by the film winding knob. The automatic ones have a foldable winding crank (**3**) and the non-automatic ones a chrome-finished winding key (**4**) or a non-foldable accessory crank (**5**).



6.



7.

The handle of the magazine slide is moved to one side (**6**A) to clear the film insert and allow it to be removed without pulling out the slide. The magazine slide can be inserted either way but the recommended position is with the handle towards the camera front (**7**).

The rear plate of the camera body

When the film magazine is removed, the rear plate of the camera is exposed. On the top righthand side is the gear wheel, which connects to the film winding mechanism in the magazine. On the bottom righthand side is the pin which operates the magazine signal, changing it from white to red each time the shutter release is pressed. The gear wheel and pin openings are the only places where dirt and dust can enter into the camera mechanism, so take care to keep them clean after the magazine is removed.

The auxiliary shutter of the 500C/M and EL/M

The purpose of the auxiliary shutter at the rear of the 500C/M and 500EL/M cameras is to protect the film from light coming through the lens and viewfinder before and after the picture is made. When the release is pressed, the top baffle plate flips up and the bottom plate down; they stay in this position until the pressure is taken off the release. The baffle plates cannot be easily damaged. They can be pushed inwards, for instance, without damaging the plates or the camera mechanism.

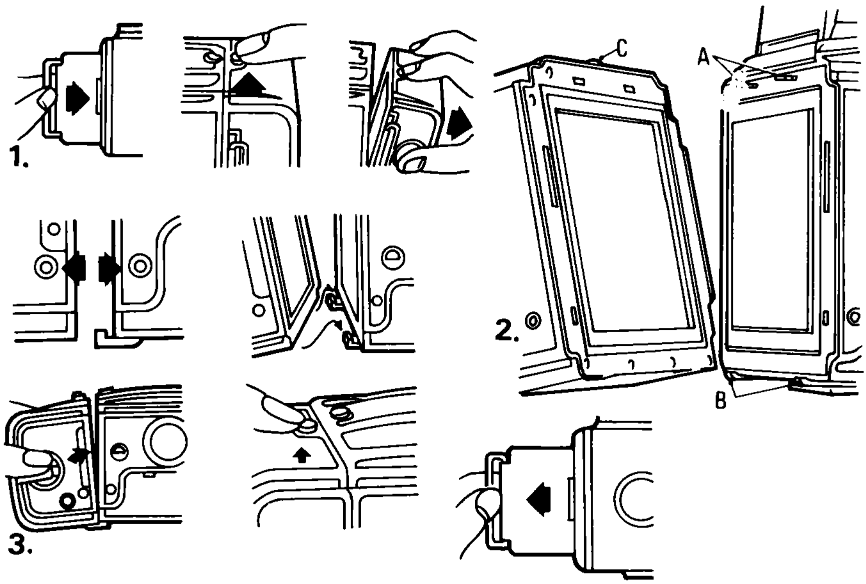
The focal-plane shutter of the 2000FC

The rear of the 2000FC camera is covered by the focal-plane shutter curtain. This has a dual purpose: it acts as a shutter controlling the exposure time, and as a rear protective curtain when the camera is used with Compur shutter lenses. In the latter case, the exposure time is controlled by the shutter in the lens. The shutter curtain is used to protect the film from light before and after the exposure.

Checking camera functions

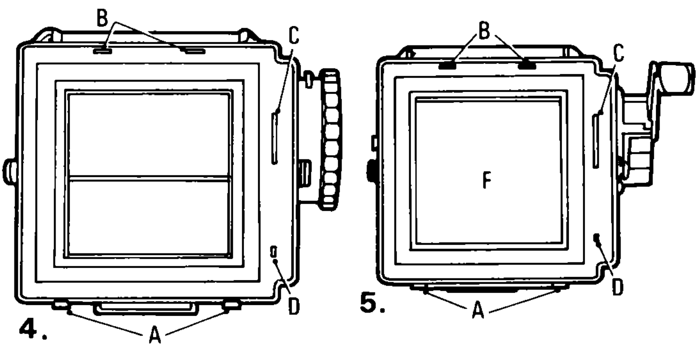
You can push the release and turn the winding crank of all Hasselblad cameras, with the magazine removed. This is extremely useful as it allows the functioning of lens and camera mechanism to be checked. With the magazine removed, it is possible to see through the camera body and lens and check what is happening when the camera is released.

Here are some of the things that should be checked regularly. Make certain that the two rear baffle plates are completely out of the light path when the release is depressed. The upper flap should lie flat against the raised mirror, the bottom flap against the bottom plate. Make certain that the two baffles close completely and tightly when the button is released. Set the aperture ring at a small aperture and check whether the diaphragm closes down to the preset aperture as it should. At the same time, make certain the diaphragm has the familiar regular shape. This indicates that all blades are operating



To remove a magazine (**1**), insert the darkslide, push the magazine lock on top of the magazine to the right, move the top of the magazine away from the camera and lift the magazine off of the two lower support catches.

When attaching a magazine (**3**), both operating signals should be white unless you are making a double exposure. With the darkslide inserted, hook the bottom of the magazine onto the lower two support catches of the camera body (**2**B) and pivot the top of the magazine towards the camera latches (**2**A) while pushing the magazine lock (**2**C) to the right. Remove the darkslide to exposure the film.



The rear plate of all Hasselblad models is identical. At the top and bottom are the catches for the film magazines (A and B). On the right-hand side is the gear (C) that connects to the camera mechanism and the pin (D) that changes the operating signal. The rear opening is covered by the auxiliary shutter (**4**) on the 500C/M and 500EL/M, by the focal-plane shutter (**5**F) on the 2000FC, and is not covered on the Superwide.

properly. Also check whether the long shutter speeds (1 sec, $\frac{1}{2}$ sec, $\frac{1}{4}$ sec) in the lens or focal-plane shutter are approximately correct.

The tests that simply involve the lens diaphragm and lens shutter operation can, of course, also be made by looking through the front of the lens instead of the rear of the camera. The most important test, only possible with the magazine removed, is the proper timing of the auxiliary and the lens shutter on the 500C/M, 500EL/M and the 2000FC when used with Compur shutter lenses. The rear curtains, or the focal-plane shutter in the 2000FC, must be fully open when the lens shutter opens and closes. To ascertain this, point the camera, with Compur shutter lens, against a bright subject and press the release while viewing through the rear of the camera. You must see the lens shutter open and close at all shutter speeds from 1 sec to 1/500 sec. This check is best done with the diaphragm wide open.

This viewing test through the rear of the camera made at the longer shutter speeds of 1/4 sec to 1 sec also proves why it is necessary to keep pressing the button until the lens shutter closes. If the finger is removed before, the rear shutter closes before the lens shutter has completed the exposure.

An even more valuable viewing test involves flash synchronization and is described in the chapter on flash.

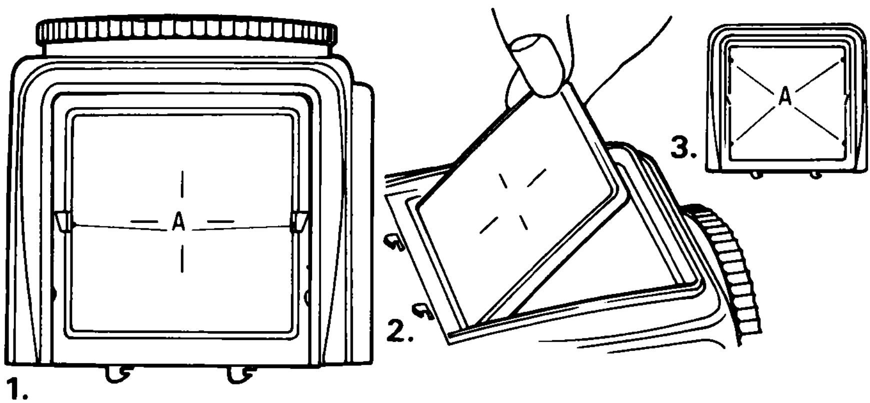
Carrying cases

Consider carrying cases not just for the purpose of carrying cameras, lenses and accessories from one place to another, but as an aid to producing better photographs, more quickly and more conveniently. Your equipment remains clean and in good working order—each item in its specific place so that it can be found instantly when needed.

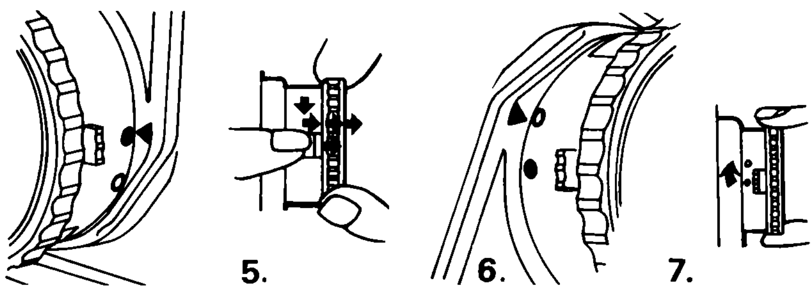
If the equipment is to be shipped or placed on airplanes as luggage, it is essential to use a metal case with internal partitions or cut outs for each item. Additional padding should be placed in each compartment so that the items cannot move or fall around.

For only one camera, an ever-ready case may be the choice. Such cases, in soft and hard leather, are available for Hasselblads. An ever-ready case does protect the camera, but the process of opening a case every time you want to take a picture may outweigh this advantage. It is best to use a case that holds and protects the camera, and perhaps additional lenses and accessories. While shooting, carry the camera without a case in your hand, over your shoulder or round your neck; carry the case, with the rest of the items, in the other hand.

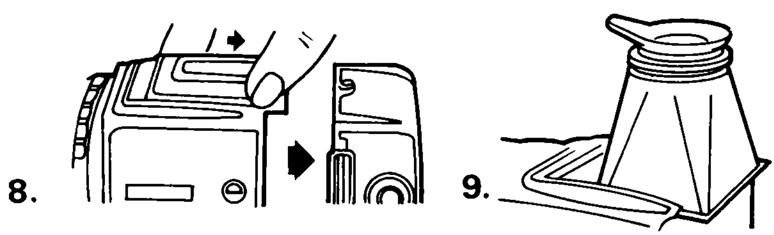
Try to find a case that holds all the items that you normally need in such a way that they can be assembled in the order they are used. If you normally work with a prism viewfinder, for example, it is an absolute necessity to have a case that holds the camera with the attached finder, lens and magazine. If



Changing ground-glass screens on the 2000FC, 500C/M and EL/M (**1**–**3**). After removing the film magazine and viewfinder, push both screen retainers (**1**A) into the camera body, turn the camera upside-down and the screen will drop out easily (if not, push gently from inside the camera body). Drop the new screen into the square opening with the finished side up (**2**). Make certain that the screen rests on all four supports (**3**A). The screen retaining clips will close automatically when the viewfinder is attached to the camera.



Changing the winding knob or crank (**4**–**7**). The normal winding knob on the 500C and 500C/M can be replaced by a winding crank or an exposure meter knob. The camera release can only be depressed when the solid red dot on the crank or knob is opposite the red triangle on the camera body (**4**). Put the camera in the ready position and push the locking device on the knob or crank away from the camera body (**5**) while turning the knob or crank counter-clockwise. Attach the knob or crank by pressing it against the camera body with its engraved circle opposite the triangular index on the camera body (**6**). Turn it clockwise and it will lock into position as soon as the red dot and triangle match (**7**).



Removing and changing the viewfinder (**8** and **9**). The viewfinders can only be removed with the film magazine detached. Slide the finder towards the rear and off the camera. Slide in the new finder from the rear making certain that it is properly placed in the guiding grooves.

the 70 mm magazine is your norm, the case must hold this camera and magazine combination. It is just too time-consuming and inconvenient to assemble camera components every time you want to take a picture. It is even an advantage to be able to leave a sunshade on the lens. The ideal case is one in which every camera can be stored ready for shooting.

Next in importance is a case in which every item can be found immediately when needed, unobstructed by others. This usually means separate compartments or holding straps for every item. It is unlikely that a case direct from the factory meets this requirement; such cases are necessarily a compromise since almost every photographer has a different assortment of cameras, lenses and accessories. It is, however, usually possible to rearrange or add separators, partitions, straps, or whatever may be necessary for a neat arrangement. Such an arrangement not only helps in finding everything when needed, but also makes it easy to see whether everything is in the case before leaving on a trip or assignment.

There are two styles of carrying cases: the shoulder case and the suitcase type. The latter is more awkward to open but it can hold more items in a more orderly fashion than a shoulder case. Suitcase styles come in leather and metal. Leather is lightweight, beautiful in style and appearance but, naturally, not as rugged as the more functional but also heavier metal type. Leather camera cases are not meant to be placed on airplanes as luggage.

In shoulder cases, cameras are lodged so that they can be removed while the case is hanging over the shoulder. Their advantage is that the camera can be hung around the neck, ready to snap a picture, while the case with the rest of the equipment is hanging from your shoulder.

Obviously, different types of carrying cases have their advantages and uses. A metal suitcase type may be useful to transport everything from location to location and then the items needed for the next shot can be transferred to a shoulder case. This is a very practical arrangement which makes location shooting most enjoyable.

4

Camera Operation

The basic camera operation

Two basic operations are required on the manually operated 500C/M, 2000FC and Superwide C cameras: the first is releasing the camera to record the image on the film; the second, advancing the film to the next frame. On the 500EL/M the second step is done automatically by the electric motordrive.

On all manual Hasselblad models, the film is advanced by a full turn of the winding knob or crank to align the two white dots. This operation also retensions the shutter in the lens, or the focal-plane shutter of the 2000FC. On the 500C/M, a full turn of the knob or crank also opens the lens diaphragm and moves the mirror down into viewing position. The same is true on the 2000FC if the mirror motion is set to 1. At 2, the instant return position, the mirror comes back into the viewing position immediately the picture has been taken.

On the 500EL/M model set to the normal O position, the film is advanced, the shutter recocked and the mirror moved into the viewing position automatically by the motordrive after the picture has been taken. On the 500EL/M camera, therefore, you see an image on the focusing screen very quickly after the release is depressed.

The operating signals

Your main interest as a photographer is undoubtedly creating good images without worrying whether camera operations have been performed properly, so Hasselblad camera bodies interlock with the lenses and magazines to fire only when all the basic operations are complete. The bodies and magazines also have signals which show at a glance whether there is a film in the camera, how many frames have been exposed or are left on a roll of film, whether the film has been advanced, and whether the shutter has been cocked.

Checking film magazines

The newer *automatic film magazines* (A12, A16, A16S, A24) are equipped with a feeler connected to the left-side plate with the locking lens insert. Next to the locking lever is a semicircular opening that is either all white, all red, or red and white combined: if the signal is all white, the magazine is loaded with a new roll of film; a partially white and red opening indicates a partially exposed film; and, a completely red signal means that the magazine is not loaded or that the film is at the end of the roll. In the latter case the last exposure may have been taken, without the backing paper that protects the exposed film having been wound up. To avoid accidental fogging of the last images on the film, turn the magazine winding crank a few times before pulling out the magazine insert.

On older *non-automatic magazines*, simply lift the cover at the rear of the magazine. The opening underneath goes right down to the film plane. When the magazine is loaded, the coloured paper backing of the film can be seen.

On the *Polaroid film magazines*, the white tab that is used to pull out the film after the exposure indicates whether film is in the magazine: as long as there is a white tab, there is film left in the magazine.

The number of exposures

All roll film magazines have a counter on the side showing how many exposures have been made. The counter is coupled to the transport mechanism in the magazine and works with or without film. It cannot, therefore, be used to determine whether the magazine is loaded with film.

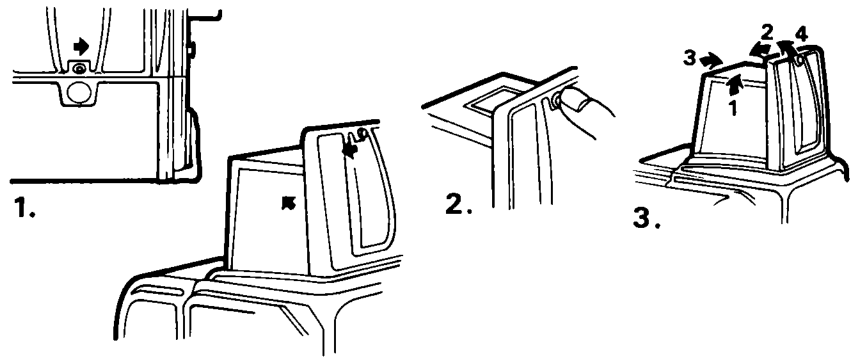
Film advance indicator

Next to the film counter, roll film magazines and the magazine 70 have a small window that shows either white or red: red before the film is advanced for the next shot, white when the film has been advanced. This signal, like the film counter, works with or without film.

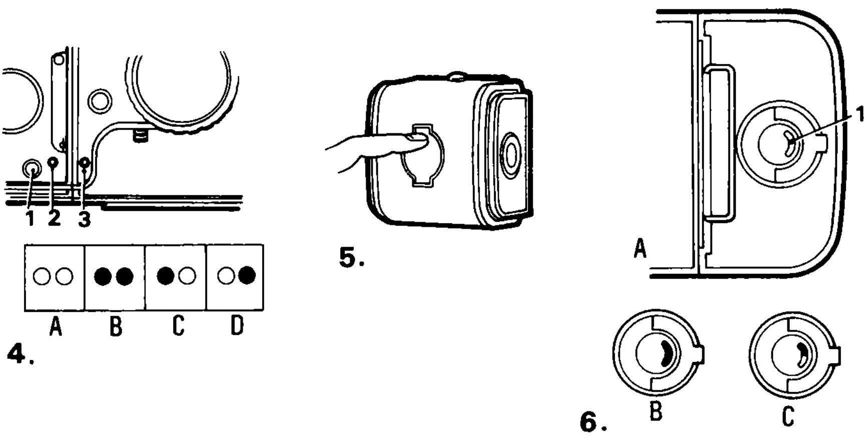
Camera-ready indicator

All Hasselblad cameras have a window identical to and immediately next to one in the magazine. As in the magazines, this window shows red or white: white when the camera and lens is ready for shooting, and red when the camera is not ready because the shutter has not been cocked.

The signal in the film magazine does not affect or change the operation of the camera. All Hasselblad cameras can be released whenever the camera signal is white regardless of whether the magazine signal is white or red.



The focusing hood is opened by sliding the lock towards the winding knob side (1), the four sides then automatically spring into position. The top shield with magnifying lens is brought into position by sliding the same lock again to the right (2). To close the hood (3), flip down the top shield and fold down the side and rear panels; the front panel locks when completely folded down.



The film counter in the magazine (4:1) and the operating signals in the magazine (4:2) and camera body (4:3). If both signals are white (A), the camera is ready and the film advanced. After exposure both signals are red indicating that the shutter is not cocked and the film not advanced (B). If the magazine signal is red and the camera signal white (C), then the camera is ready for shooting but the magazine not advanced. If the magazine signal is white and the camera red (D), then the advanced magazine is attached to an uncocked camera.

If a non-automatic magazine is loaded with film, you will be able to see the paper backing of the film when the film indicator window is opened (5). When an automatic magazine is newly loaded, the film consumption indicator (6:1) is all white (A), when there is no film or a completely used film the indicator is all red (B). A partially exposed film is indicated by an intermediate position (C)—red and white.

CAMERA AND MAGAZINE SYMBOLS

Camera	Magazine	Meaning
White	White	Camera ready (or prereleased), film advanced.
Red	Red	Camera not ready, film not advanced.
White	Red	Camera ready (or prereleased), film not advanced—ready for multiple exposure.
Red	White	Camera not ready. Film advanced.

Focusing hood

The focusing hood on the 500C/M, EL/M and 2000FC cameras serves two purposes: to shield the focusing screen from extraneous light so that the image appears bright and easy to focus with a corner-to-corner view; and to carry the magnifier for the ground-glass image. You can view the screen with or without the magnifier (which is in the top cover of the hood). It is best to use the magnifier for focusing as the ground-glass image is magnified four times. Focusing is, therefore, likely to be more accurate. Put your eye close to the magnifying lens when using it to see the entire ground-glass area. The corners are not exceptionally sharp, so it is recommended that you always focus in the centre of the ground glass. This is obviously impossible or impractical with eyeglasses, so it is better to focus without them if you can. If you cannot see a sharp image of the ground-glass screen without your glasses, accurate focusing can be a problem. You need to see only the centre, not the entire ground-glass area. After focusing, either remove your glasses and compose the image with your eye very close to the magnifier, or flip the magnifier down and compose the image by looking directly on the ground glass.

Another possibility, that provides not only a sharp image but also more comfortable viewing, is to switch to the magnifying hood or one of the eye-level prism viewfinders. These are either equipped with a dioptre correcting eyepiece or are capable of holding correction lenses.

Aperture and shutter speed setting: Compur shutter lenses

On Compur shutter lenses the aperture and shutter speed rings are interlocked. Rotating the knurled ring in front of the shutter speed engravings not only changes shutter speeds but apertures as well. Aperture and shutter speed rings can be set separately by pressing the cross coupling lever towards the camera body with the right hand. You can then change the shutter speed or aperture ring independently with the left hand. The fastest way to set aperture and shutter separately is to set first the shutter speed with the coupled rings, then depress the cross coupling lever and turn the aperture ring alone until the desired aperture is opposite the index and selected shutter speed. Compur shutter lenses can be set at the engraved apertures or halfway between.

Shutter speeds can be set only at the engraved figures. If set in between accidentally, the shutter will operate at one of the engraved figures next to it.

Aperture and shutter speed setting: non-shutter lenses

On the 2000FC lenses without shutter, aperture and shutter speed rings can be operated separately or coupled. The shutter speed ring, which is part of the camera body, is set with the left thumb, either at the engraved shutter speeds from 1 sec to 1/2000 sec or halfway between them, for example, between 2 and 4 the shutter speed is 1/3 sec, between 500 and 1000, 1/750 sec etc.

Apertures are set by turning the ring at the rear of the lens. This is best done by holding the ring with thumb and index finger of the right hand at the two knurled projections at the bottom and right-hand side of the ring. The 2000FC lenses permit simultaneous setting of aperture and shutter speed—the aperture with the right hand, the shutter speed with the thumb of the left hand, while the camera is held with the same hand and the index finger kept on the release.

Aperture and shutter speed rings can also be coupled by pressing the cross coupling button on the aperture ring, so they work like the shutter lenses.

Using long shutter speeds

All Compur shutter lenses as delivered from the factory have a red band above the shutter speed figures 1, 2 and 4 (corresponding to 1 sec, 1/2 sec and 1/4 sec shutter speeds). This band is simply a reminder that the camera release must be kept depressed until the sound of the shutter closing is heard. If this is not done, the rear curtain closes before the exposure is finished. The same precaution needs to be taken on the 2000FC when the Compur shutter in the lens is used.

Time exposures

When shutter speeds longer than 1 sec are necessary, the Compur shutter in the lens or the focal-plane shutter in the camera is set to B. The shutter then stays open as long as the release is depressed with the finger or a cable release. If time exposures are made with Compur lenses on the 2000FC, both shutters are set to B. Cameras or lenses set at B are still flash-synchronized with the flash firing the moment the shutter is fully open.

Green time exposure engravings

On the left side of B, all Compur shutter lenses have green figures from 4 to 125. Being on the shutter speed ring, it can be correctly assumed that they represent exposure times from 4 sec to 125 sec. They cannot, however, be set

opposite the index. The shutter speed ring stops at B because the shutters in the lenses are timed only for speeds from 1 sec to 1/500 sec plus B. The green numbers simply indicate how long the exposure time must be at each of the apertures engraved next to the green numbers. It is just like a scale on an exposure meter. To clearly understand this, set one of the Compur lenses at EVS 4. The shutter speed/aperture scales look like this:

30	15	8	4	B	1	2
22	16	11	8	5.6	4	2.8

Two things are definitely clear. Correct exposure for EVS 4 is obtained at *f*2.8 and 1/2 sec or at *f*4 and 1 sec. If more depth of field is necessary, correct exposure can also be obtained at: 30 sec at *f*22; 15 sec at *f*16; 8 sec at *f*11; 4 sec at *f*8; and, 2 sec at *f*5.6 (letter B also stands for 2 sec).

To obtain shutter speeds longer than 1 sec, set the shutter speed ring at B and the desired aperture opposite B and the index. Keep the shutter open for the indicated number of seconds by consulting a stopwatch or counting seconds. For example, with EVS 4 the correct exposure time at *f*16 is 15 sec: set shutter speed ring at B; set the aperture at *f*16; and depress the shutter release for 15 sec.

Distance setting

Now that aperture and shutter speed selection has been discussed, a word must also be said for the third lens setting—the distance. The distance setting can be determined through ground-glass focusing on the main subject, or be based on the depth of field scale.

The above are technical considerations. It is equally important to set the distance from a creative point of view. When photographing three-dimensional scenes, there are several different focusing possibilities: focusing on the foreground with the background blurred; on the background with the foreground out of focus; or somewhere in between, in which case foreground and background may be blurred or sharp.

It is very valuable to experiment with the different focus possibilities on almost every subject. Too often a focusing scale is set simply for the distance that appears most logical. Many times a more interesting image may result when the lens is focused on another plane, for example a tree in the background instead of the flowers in the foreground, or a weed in the foreground instead of the beach-house in the background. After taking the picture with the 'logical' focus setting, turn the focusing ring while watching the change in the image on the ground-glass screen. It is surprising how many different images can be discovered, especially when using longer focal length lenses where the focus changes rapidly.

Focusing the Superachromat

On all Hasselblad lenses except the 250 mm Superachromat, the distance ring stops at infinity. The 250 mm f5.6 Sonnar Superachromat does not stop at the infinity mark but can be focused a few millimetres beyond this point. This is because the optical characteristics of the fluorite element in this lens are more sensitive to changes in temperature than the elements in conventional lenses. The distance engravings, therefore, may not be accurate enough for the critical work for which this lens is often used. Focusing should always be done based on the image on the ground-glass screen. The distance scale is only there to provide a certain amount of guidance.

Roughness in the focusing mount

Sometimes, the helical focusing mount may operate a little roughly when the lens is on the camera. This is not due to wear and tear or any defect but to the fact that the telescopic shaft, which runs from the rear bayonet mount on the lens to the between-the-lens shutter, is not in its correct position. Just make an exposure and advance the film. The shaft then falls into place, and the roughness previously felt is eliminated.

Releasing the camera

Hasselblads can be released when their camera signal is white. With a magazine in place, the counter must show that there is film left, and you must pull out the darkslide, at least half way on the newer automatic magazines and a few millimetres on earlier ones.

The shutter release is on the front of all the SLR models, and on the top of the Superwides. Even with the release placed in the most favourable position, steadiness is determined by the way you operate it. Push it slowly and gradually, so that you hardly know when it goes off. The releases have some free play to avoid accidental exposure at the slightest touch of the release. If you want to wait for the exact moment, take up the first pressure of the button so that, at the right moment, just a slight additional pressure on the release makes the shutter click. Other suggestions for camera steadiness will be found in the chapters on holding the camera and tripod use.

With shutter speeds of 1/8 sec or longer, remember to keep the shutter button (or cable release) depressed until the lens shutter (on 500C/M, 500EL/M and 2000FC) closes. Otherwise, the auxiliary shutter cuts off the exposure too soon. On the 500EL/M the film starts to move as well, which can produce streaking from highlight areas.

The 500EL/M release button is a separate item that is inserted in either one of the two openings at the front of the 500EL/M camera. It makes no difference

which opening is used. You can use one opening for the small release button and the second for any of the FK release cords, which are available in different lengths. The release of the EL/M is by electrical contact, not mechanical means. Neither a standard cable release nor a double one can be used directly. A release adapter is available for this purpose.

The release cycle

Pressing the shutter release brings into action the whole train of operations needed for taking a picture. Removing the pressure resets the 500EL/M for the next shot. Other models are reset with the winding crank or knob.

The 2000FC camera. What happens on the 2000FC camera when the release is depressed depends on whether the focal-plane or the lens shutter is used and whether the mirror is set to position I, where it operates as on the 500C/M, or in position II, the instant return position.

When the lens shutter is used, the cycle is identical to that of the 500C/M, except that the focal-plane shutter opens instead of the auxiliary shutter. As on the 500C/M, the image does not appear on the ground glass until the winding crank is turned. The finger must be pressed on the release until the lens shutter closes, even with the mirror in the instant return position. The mirror does return instantly when the release is depressed but there is no image on the ground glass because the lens shutter is closed and does not open until the winding crank is turned.

With the focal-plane shutter the following things happen when the release is depressed:

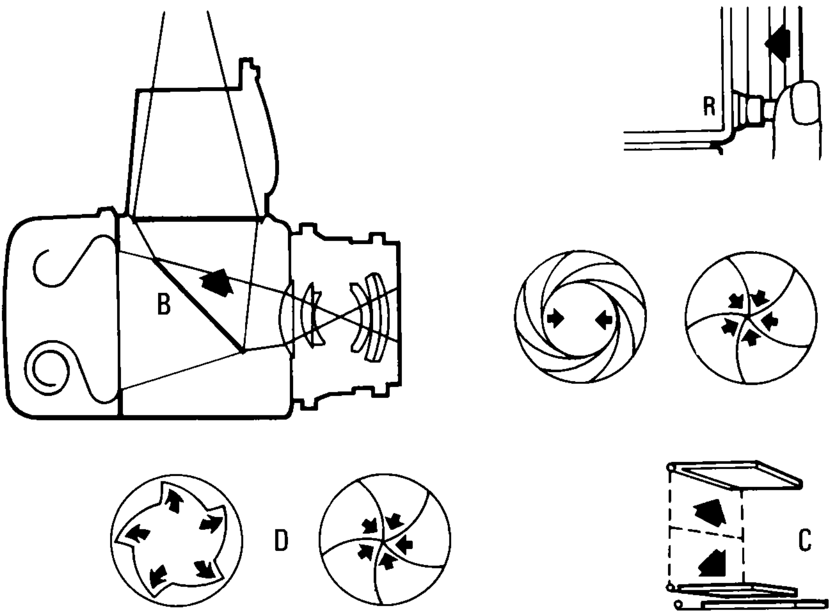
1. The diaphragm in the lens closes to the preset aperture.
2. The mirror moves up and out of the light path.
3. The focal-plane shutter makes the exposure for the set time.
4. The mirror returns instantly when set to the instant return position.

Nothing happens when the finger is removed from the release, unless the shutter is at B, in which case the focal-plane shutter closes.

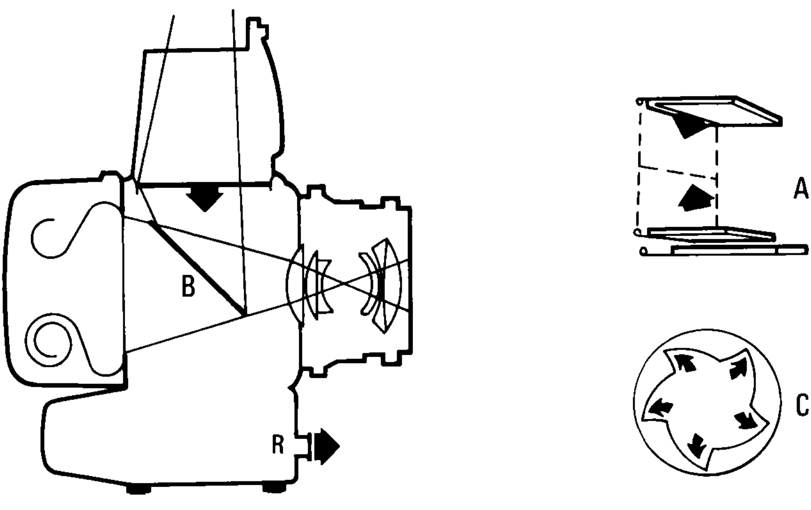
When the winding crank is turned:

5. The mirror flips down if the control was set to position I.
6. The focal-plane shutter is recocked.
7. The lens diaphragm opens.
8. The film is advanced.

The Superwide C. The release cycle on the Superwide is short as there is no mirror, no auxiliary shutter and no automatic aperture stop down as the diaphragm opens and closes while the aperture ring is turned. When the shutter speeds on the Biogon lens are set anywhere from 1 sec to 1/500 sec, depressing the release simply opens the lens shutter and closes it after the exposure is made. The release need not be kept depressed until the shutter closes. When the shutter is set to B, the shutter stays open as long as the release is kept depressed, then closes.



The release cycle on the 500C/M and 2000FC when the Compur shutter in C lenses is used. When the camera release is depressed, the lens shutter closes and the diaphragm stops down to the pre-set aperture (A), the mirror moves up and out of the light path (B) and the auxiliary shutter (focal-plane shutter in the 2000FC) opens (C). The lens shutter opens and closes for the duration set on the shutter speed ring (D). When the lens is set to 'B', the shutter stays open as long as the release is depressed.



The release cycle on the 500EL/M is identical to that on the 500C/M. When the finger is removed from the 500EL/M release, the auxiliary shutter closes (A), the mirror flips down (B), the lens shutter and diaphragm open (C) and the film is advanced.

Purpose and use of the release lock

The 500C/M and Superwide. The releases on the 500C/M and Superwide models are equipped with a release lock which consists of a tiny lever around the release button. It can be rotated to two positions—O or T. Set to T, the release button stays in, even when you remove your finger. It comes back to the original position only when the lever is set back to O. This means that the lens shutter, set on B, stays open until the lock is put back to O. It is one way of making long time exposures. On the 500C/M, the rear curtain stays open and the mirror in the up position, out of the light path. The film winding knob or crank on the 500C/M or Superwide cannot be turned when the release lock is set at T. A better way of making time exposures, however, is by prereleasing the camera and using a cable release, in which case the camera release lock has no effect.

On the 500C/M the lock has three uses: to keep the release in the depressed position when long exposures are made; to keep the rear auxiliary shutter open when shutter speeds from 1/4 sec to 1 sec are used; and to keep the rear auxiliary open when the self-timer is used.

On the Superwide, the lock has only one practical application: to keep the shutter open in time exposures. Locking the release is not necessary when using the self-timer.

The 2000FC does not need the release lock. Self-timer exposures are made with an accessory that does not require it, and long time exposures are better made with a locking cable release. Self-timer exposures can be made on the 2000FC without the accessory when Compur lenses are used. The procedure is basically the same as on the 500C/M. The release must be locked in the depressed position with a cable release to keep the focal-plane shutter open until the exposure is made.

The 500EL/M release lock is built into the camera body. On the side of the battery compartment is a lever with three positions: O, L and T. When the lever is set to L, the EL/M camera cannot be released, preventing accidental exposure without needing a darkslide or removing the release button. The lower T position can be used for time exposures. With the lens set to B, the shutter opens when the lever is moved to T and closes when moved back to O. Moving the locking lever can cause camera motion, and therefore, time exposures are better made with a cable release after prereleasing the camera. The locking lever, however, can also be used for releasing the camera. Moving the lever to T always releases the camera regardless of whether it is set to B or any other shutter speed. It works just like the release at the front of the camera. Moving the lever to T triggers the camera through mechanical, not electrical, means. The shutter can therefore remain open without any drain on the battery.

The self-timer on the 500C/M, 500EL/M and Superwide

With the self-timer, the exposure is made approximately 8 sec after the release is depressed, so you can take your own picture, joining the rest of the group posed in front of the tripod-mounted camera.

Self-timer exposures are made by setting the flash synchronization lever on the left side of each lens to V. The lever cannot be moved without releasing its lock. This requires two hands. It is purposely made rather difficult.

The rear curtain of the SLR models must remain stationary 8 sec after the release is depressed. The release lock lever must be moved to the T position whenever the self-timer is used. If a cable release is used, it must be locked in the depressed position. The flash synchronization lever automatically jumps back to X after each exposure, so that V must be selected each time a delay is required. The self-timer position V is synchronized for electronic flash.

Prereleasing the camera

Before an exposure can be made on the 500C/M, 500EL/M or 2000FC models with a Compur shutter, the lens shutter must close completely, the aperture must close to the preset opening, the mirror must move out of the way and the auxiliary or focal-plane shutter must open. The required operations take a little time. The picture is taken approximately 1/25 sec after the release is depressed. For sports photography or other action shots, it is possible to set the camera in a prerelease mode to avoid the time delay.

Prereleasing simply means performing the operations that cause the time delay first. Then, when you depress the release, the first and only thing that takes place instantly is the opening and closing of the shutter in the lens.

The second use of prerelease is to reduce the possibility of camera shake when the camera is mounted on a tripod or stand. It is easy to understand that any moving element inside a camera can cause camera motion or vibration. The fewer operations that take place the moment the picture is made, the steadier the camera is likely to be. This is exactly what prereleasing the camera does, i.e. most of the release operations are performed before the picture is made. The aperture and shutter closing, the lifting of the mirror and the opening of the rear curtain are all done when the prerelease is depressed. When the camera release is depressed to take the picture, only the lens shutter opens and closes. The lens shutter is extremely smooth as the shutter blades move in all directions, reducing or eliminating the possibility of camera vibration even when the camera is mounted on a tripod or stand of questionable sturdiness.

It is, therefore, recommended that the prerelease is used with shutter speeds from 1 sec to 1/15 sec and when time exposures are made.

There is no reason to use the prerelease for self-timer exposures as all the functions that the prerelease performs are done when the release is depressed, approximately 8 sec before the shutter goes off.

Prereleasing is not possible and would serve no purpose on the Superwide as it has no mirror or rear curtain. There is also no time delay; the exposure is made the instant the release is depressed.

Prereleasing the 500C/M. The prerelease control on the 500C/M is below the winding knob and is pushed upwards. As the mirror lifts up, the image on the ground-glass screen disappears. If for some reason you need to see the ground-glass image before making the exposure, turn the winding knob or crank with the magazine removed from camera, so that the film is not advanced.

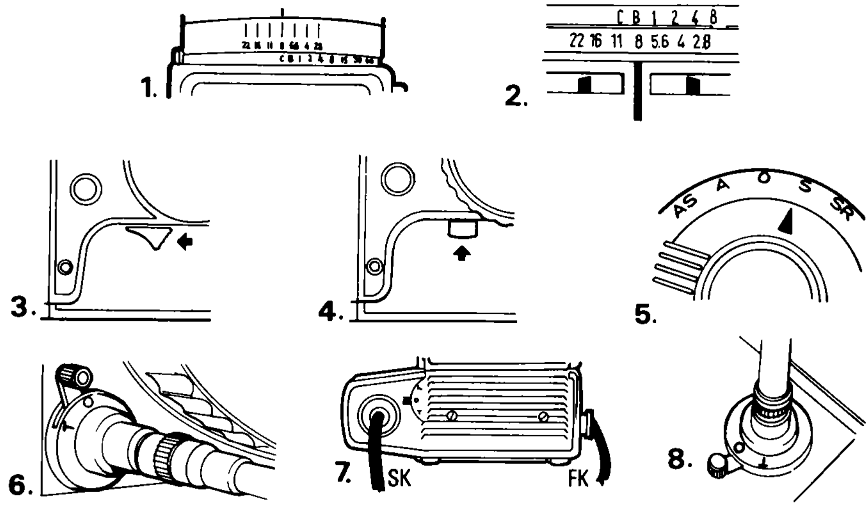
Prereleasing the 2000FC. The prerelease button on the 2000FC is in the same position, below the winding crank, as on the 500C/M, but the camera is prereleased by pushing the control towards the rear of the camera instead of upwards. If the shutter in a C lens is used for the exposure, prereleasing performs the same function as described above. If the focal-plane shutter is used for the exposure, prereleasing only closes the diaphragm to the preset opening and lifts the mirror. The main moving element, the focal-plane shutter, moves when the release is depressed, and the advantage of the prerelease for camera steadiness is, therefore, questionable. The focal-plane shutter movement is dampened to a high degree, but is still more likely to create camera motion than a lens shutter. If C lenses are used on the 2000FC, using the shutter in the lens is a better choice for maximum camera steadiness whether the prerelease is used or not.

Prereleasing the 500EL/M. Prereleasing the 500EL/M performs the identical camera operation as on the 500C/M and should, therefore, be used for the same purpose, i.e. to eliminate the time delay and reduce possibility of camera motion. The 500EL/M is prereleased by setting the operating knob to S. As it hits the S position, the lens shutter closes, the aperture presets itself, the mirror rises and the rear curtains open. The control does not stay in the S position but moves back to the normal O position. The exposure is made the instant the release is depressed. When the finger is removed from the release, the camera returns to the normal position, with the lens open, the mirror down, and the ground-glass image again visible.

The EL/M also has another prerelease position—SR. When the knob is turned to SR the prerelease operations are the same as in the S position, the only difference is that the knob remains at SR so that, after the exposure is made, the camera is back in the prereleased position. The SR position is used when all images are made in the prereleased mode without the need for seeing the ground-glass image in between.

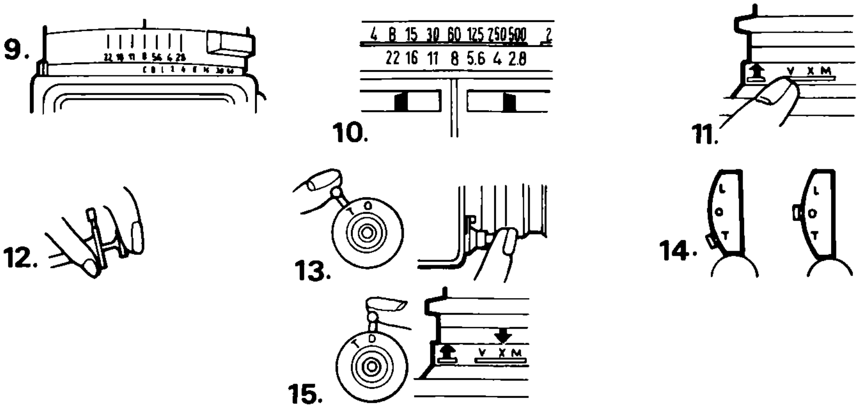
Holding and supporting the camera

Preparing to take a picture means deciding whether to hold the camera by hand or support it on a tripod or other stand. A Hasselblad is ideally suited for both approaches.



Making time exposures

On the 2000FC, set the camera shutter to C (**1**). For all cameras—the SWC, 500C/M, 500EL/M and 2000FC—set the lens to the required aperture and the shutter to B (**2**). Prerelease the 2000FC (**3**), the 500C/M (**4**) and the 500EL/M (**5**); the SWC does not require prereleasing. The shutter is held open by pressure on the release button at the front of the 2000FC and 500C/M (**6**) and on top of the SWC (**8**); the button may be locked by moving the lever to 'T' or released by a cable connection. The 500EL/M can be released by any of the ranges of FK or SK cables (**7**).



Using the selftimer

On the 2000FC, set the camera shutter to 'C' (**9**). For all cameras—the SWC, 500C/M, 500EL/M and 2000FC—set the required aperture and speed on the lens (**10**). Set the selftimer lever on the lens to 'V' while pushing up the lever to the left (**11**). Release the camera so that the rear shutter stays open: on the 2000FC with a lockable cable release (**12**); on the 500C/M by moving the locking lever to 'T' (**13**); and, on the EL/M by moving the time lever at the bottom right-hand side of the camera to 'T' (**14**). There is no rear shutter on the SWC so only the shutter release is depressed.

After exposure, return all locking levers to position 'O'; the selftimer lever on the lens will automatically move back to X (**15**).

A hand-held camera is particularly suitable for selecting a variety of heights and angles, which is an important part of photography. Using a tripod does not preclude this, but does restrict you. The best approach is to investigate all the possible angles, lenses and lens settings *before* placing the camera on the tripod. Move around the subject with a hand-held camera; view it from every angle, from different distances, through different lenses; go down on the ground and view it from below; go as high as possible and look down. Only when you have thoroughly exhausted all possibilities and found the most effective camera position is the tripod set up and the camera placed on it.

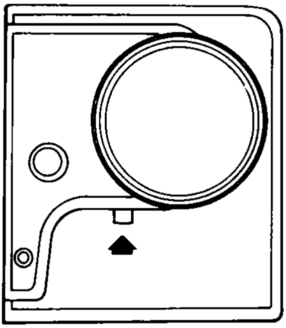
Steadiness is not the only reason for using a tripod. A mounted camera leaves you free to move around, and allows you to communicate more directly with your subjects. Once you have lined up a shot, you can be quite sure that the camera is level, and that the framing will remain exactly correct.

Hand-held photography

Any of the Hasselblad models can be used hand-held, down to the same slow shutter speeds that are acceptable on 35 mm cameras. Whether you use a grip or hold the camera alone is a personal decision. Try it out, and do not feel that you have to follow the instruction manual on holding your Hasselblad. For instance, the camera is normally held in the left hand, so the right hand is free to advance the film or perform the other camera operations. When working with telephoto lenses 250 mm and longer, a steadier hold may be achieved by doing the opposite: holding and releasing the camera with the right hand while the left hand is wrapped around the lens barrel.

Practice holding the camera, trying different methods until you find the way that suits you. But, however you hold the camera, you need a firm foundation. Start with the feet. Stand with your feet apart, and press your elbows into your body as additional bracing. Now comes the most important point: hold the camera with both hands and press it into your face or chest. The face is a most important support point. To hold something steady you need two forces opposing each other, so pull the camera towards you. The direction of the action depends on the viewfinder. With a vertical view, pull the camera up and push your face down. With a 90° or 45° view pull back, or diagonally upward. For lower level shots, pull the camera firmly in towards your body.

When shutter speeds become too long for steady hand-held photography, some kind of support is necessary. Before rushing to select a mechanical camera support investigate other methods such as leaning the body, head or camera against a wall, post or tree; resting the camera or your elbows on a table, car, the ground or any other suitable surface. Rather than placing the camera directly on the surface, perhaps try a bean bag, which shapes itself to the contours of the surface and camera making it more difficult to move the camera. For low camera angles, lie on the ground and use your elbows as a support.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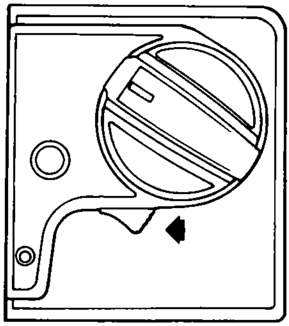
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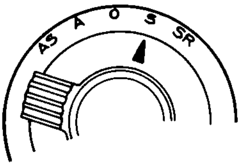

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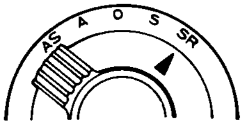

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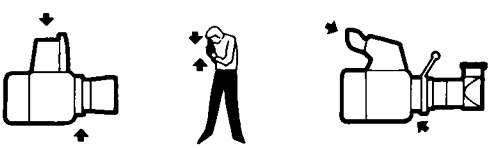
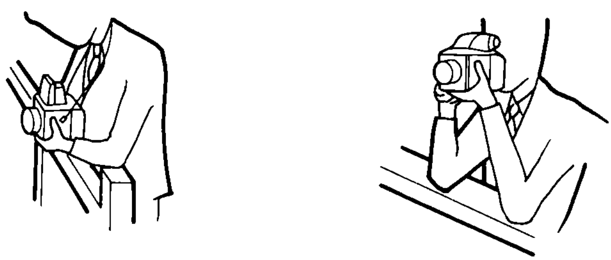
Prereleasing cameras

The 500C/M (1) and 2000FC (2) cameras are prereleased by pressing the lever below the winding crank or knob upwards on the 500C/M and towards the rear on the 2000FC. In both cases the prerelease procedure closes the lens shutter, stops down the diaphragm to the preset aperture, raises the mirror and opens the camera shutter; thus when a photograph is taken the only movement is by the camera shutter. The prerelease mode is primarily intended for vibration-free results in critical work but it may also be used to reduce the camera reaction time to a minimum when shooting, for example, rapid action.

The 500EL/M cameras can be prereleased in two ways: by setting the selector dial to S (3) or to SR (4). When set to S, the camera returns to its normal viewing state after exposure; at the SR setting, the camera returns to the prerelease state after one transport cycle.





Best camera steadiness is obtained when two forces work against each other, such as the eye pressing the camera down or forward and the hand pressing it in the opposite direction. With the standard finder and magnifying hood, the hands press the camera upwards, the eye pushes it downward. With the 90° finders, the hands push the camera backward towards the face, the eye pushes it forward. With the 45° finders, the two forces work diagonally. Whenever possible try to find natural supports for elbows for example a fence or brick wall.

Tripods

The first thing to ascertain when choosing a tripod is how steadily it holds the camera. From this point of view alone, undoubtedly it would be safe to use the largest, heaviest studio model for all work. Tripods, however, are taken in the field, so there must be a compromise between steadiness and portability.

Besides being a solid stand, a tripod must be designed for fast, convenient operation, so that it is a pleasure rather than a nuisance working with it. The points that I recommend you look for, in order of importance, are: steadiness; convenience of viewing and operating the camera; tripod head locks strong enough to hold any combination of equipment in all positions; ease of setting up; quick camera mounting and release; convenient adjustment of camera height and angle; portability; and, the possibility of changing magazine without removing the camera.

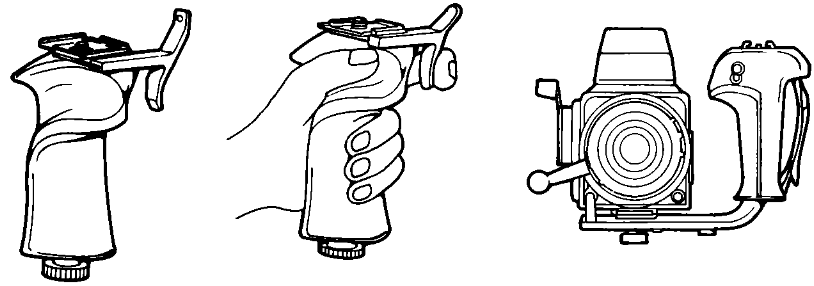
Tripod for camera steadiness

Camera steadiness is determined not only by the design of the tripod but also by the weight that is placed on it. A heavy camera is held steadier simply because of its greater downward force. Preventing camera shake during exposure is not so much a function of tripod size as it is of tripod construction and the method of operating the camera. The photographer can do much to get maximum camera steadiness from the lightest tripod. Hasselblad cameras have mirror and shutter motions that are exceptionally well damped to reduce, if not eliminate, camera motion. Nevertheless, it is only logical to do as many of these 'motion producing' functions as possible before the exposure is made, which is the purpose of the prerelease on all Hasselblad SLR models. Use the prerelease with a tripod-mounted camera whenever practical, especially when shutter speeds become longer than that recommended for hand-held camera/lens combinations.

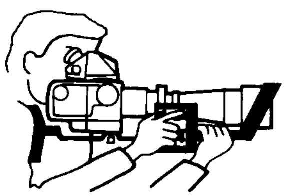
Operating the tripod-mounted camera

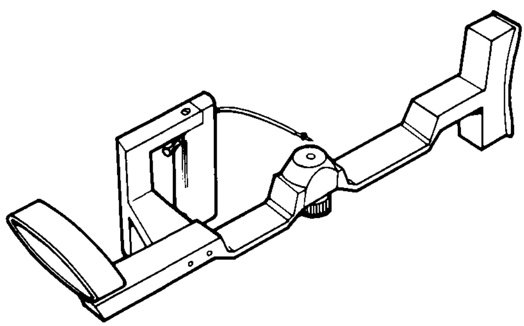
There are two theories of working with a tripod. Firstly, there is the 'free standing' theory. The photographer stands away from the tripod making certain that his body does not come in contact with the tripod or camera. The camera is released with a cable or remote release. Camera steadiness is then completely dependent on the tripod. This approach *must* be used when exposure times exceed 1 sec.

In the other method, the camera is held like a hand-held camera: either both hands are on the camera or perhaps one hand on the camera, the other on the tripod, but both pressing the tripod and camera towards the ground. The tripod serves simply as an additional support. The camera can be released with cable, or directly with the release. If carefully done, direct releasing is

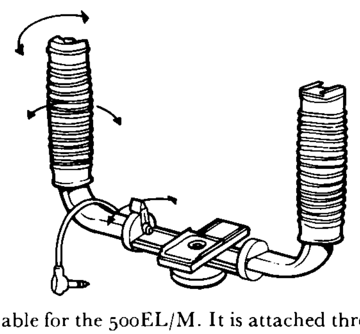


Pistol grips, available for the 500EL, EL/M, 500C, C/M and 2000FC, allow convenient and steady hand holding of the camera. The grips are attached to the tripod shoe of the camera and locked by the screws at the bottom. They are designed to be held in the left hand, leaving the other free to operate the camera. The flashgun brackets, available for the 500EL/M, 500C/M and 2000FC, have a similar steadying effect. The newer types have a wrist strap and an internal connection to trigger the camera release; the older versions have a cable release. The brackets are attached to the tripod shoe of the camera and are locked by the screw at the bottom. An additional lock, to the right of the tripod lock, prevents accidental release.

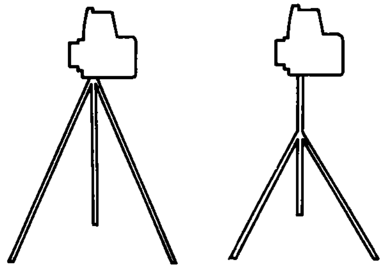




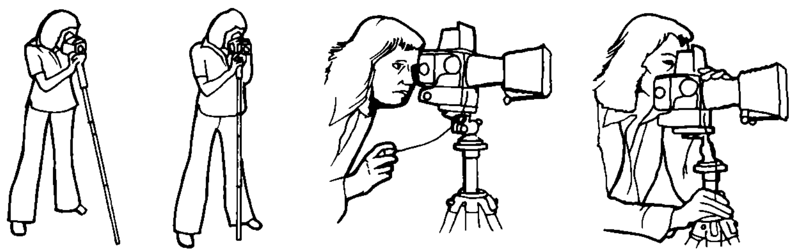
When using long lenses, e.g. the 500 mm, the combination of the gunstock (available for the 500C/M, 500EL/M and 2000FC) and 45° viewfinder can improve camera steadiness in hand-held photography. When the camera is attached to the gunstock through the tripod shoe, the lens is held by the velvet-lined ring at the far end while the other padded end is pushed into the shoulder. The gunstock handle may be positioned on the left or right. The camera is fired by the trigger in the handle through a cable release. A cable release adapter is necessary for the 500EL/M.



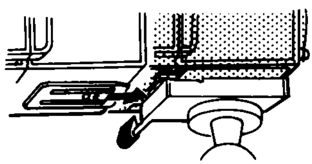
A double handgrip is available for the 500EL/M. It is attached througb the tripod coupling shoe and locked with the screw at the bottom. The attachment bracket can be moved backwards and forwards to balance the various combinations of camera and lens, and both grips can be swivelled and locked to provide a convenient holding position.



The steadiest position for a camera and tripod combination is when the camera rests directly on the three legs of the tripod and the centrepost is not extended. The centrepost should only be used for minor height adjustments—when extended too far it is very susceptible to vibrations.



The steadiest position for a monopod is when it forms the 'third leg' of a 'tripod' with the photographer's two legs, and the camera is pushed firmly against the face. In this position the two forces oppose each other, which is not the case when the monopod is vertical.
When exposure times exceed 1 sec, the body and hands should not be in contact with the camera; a cable release should be used. For shorter times, steady the camera by pressing it firmly towards the ground with the hands and face.



A tripod quick-coupling permanently attached to the tripod head can save time when setting up a tripod shot. The camera is slid onto the accessory and locked in place by turning the lever.

just as good. With shutter speeds not exceeding 1 sec, the 'tripod/body' combination seems best. Properly applied, it produces absolutely sharp results even with light-weight tripods.

Using the centre post

The most solid, vibration-free support for the camera is obtained when the camera sits directly on top of three legs, not on top of a single post. From this point of view a tripod without an elevating extension is best, although, obviously an elevating extension is convenient for lowering or raising the camera. Keep in mind, therefore, that the centre post reduces camera steadi-

ness when raised extensively and may nullify completely the advantage of a heavy tripod with good leg construction. The centre post should never be considered as part of the tripod height. It is essential to be able to set the tripod to the maximum desired height without using the centre post.

Tripod head

The tripod head should hold the camera without using excessive force on the locking lever, not only in a horizontal position, but when tilted up or down at any angle and with any of the lenses and accessories normally used. A head that allows the camera to be tilted up and down and also 90° sideways, for levelling or other purposes, without having to readjust the legs is preferred. The platform of the head should be large enough to hold the camera so it does not easily move when the camera controls are operated, and especially not when the film is advanced. Neither the platform, nor any other part of the tripod must interfere with camera operation. For the 500 mm Tele Tessar with its own tripod socket, large tripod heads are available that allow mounting both camera and lens on the head.

Hasselblad tripod coupling

Most tripods hold the camera to the platform by means of a screw, usually underneath the platform, and attachment can be a most inconvenient and time consuming process. The locking screw is not easy to reach and practically impossible to operate with gloves.

Locking screws of this type can be dangerous as they are usually made long to accept any type of camera, and are frequently forced into camera bodies causing expensive damage to the inside of the camera. All these problems are eliminated with the Hasselblad tripod coupling, which allows instant attachment and removal of the camera. The coupling is attached to the tripod and left there, becoming a part of the tripod. The camera slides into the adapter plate where it is held by a snap lock; in addition, it is locked with a simple, quick, lock lever. To remove the camera, the locking lever is released and the snap lock lever pushed up; the camera slides right out.

Tripod screws

There are two standard types of tripod screw, the smaller, so-called American, and the larger European type. The 500C/M, the Superwide and the tripod coupling carry both sockets, the 500EL/M and 2000FC carry only the larger type. The larger type is highly recommended for all Hasselblad cameras. It allows much more solid fastening without worrying about wearing out the threads on tripod or camera. Placing a tripod bushing into the large tripod socket of the 2000FC and EL camera so that the small screw can be used is

not a recommended procedure. Better professional tripods come either with both types or a reversible type. For other tripod types, the larger screw may be available on request.

Other camera supports

Tripods are not the only means of steadying a camera.

Camera clamps can be attached to almost anything: doors, tables, trees, window panes, railings, chairs, etc. While basically made for 35 mm cameras, they can be used with Hasselblad. To eliminate all possibility of camera-induced motion when the exposure time does not exceed 1 sec, hold the clamp-mounted camera with both hands with your eye pressed firmly against the camera body.

Table tripods are miniature tripods which hold the camera a few inches above the supporting surface. They can be placed on tables, cars, rocks and so forth. Placed on the ground, they are very good accessories for low angle photography, especially of flowers and other nature subjects. Maximum camera steadiness at shutter speeds less than 1 sec again depends on how the camera is held.

Special application supports. All tripods are made for what could be called normal shooting heights, i.e. 5–6 ft. For photography from lower levels, some tripods are made so the legs can be spread beyond their normal position. Other tripods allow attachment of the camera to the bottom of the centre post or the centre post can be inserted upside down, so that the camera is between the legs.

Monopods. Excellent camera steadiness can be obtained with a monopod which is much easier to carry and quicker to set up. A monopod may not guarantee sharp images at 1 sec, but it is certainly possible to obtain sharp results down to $\frac{1}{4}$ sec. Considering its convenience in carrying, serving as a walking stick during a hike, and the short time required to set up, it is well worth considering. Most photographers keep the monopod straight up. However, by moving its foot about two feet forward and tilting it towards you, it forms the third leg of a tripod with your own as the other two. Eye pressed against the viewfinder, elbows pressed against your body and either both hands on the camera, or one hand on the camera and the other on top of the monopod, provides a steady grip. Pull the camera and monopod towards your face, and press the whole outfit forward into the ground. Direct releasing without a cable is probably preferable.

5

Film Magazines

ALL HASSELBLAD ROLL film magazines are of the same design and are used in the same way. All roll film magazines and the magazine 70 also take the same dark slide. Each magazine consists of three parts: the shell, the magazine slide and the roll holder that holds the spools.

Magazine shells have serial numbers at the bottom of the plate that attaches to the camera. Every roll holder has a serial number too. It is engraved between the two film spools and consists of three numbers, which should correspond to the last three digits on the magazine shell. For example, if the magazine number is VC482232, the number on the roll holder is 232. If roll holders are switched during the process of photography, the magazine still works but spacing between images may not be as even and as accurate, and the older type magazines may possibly leak light. It is, therefore, a very good idea to make sure that the magazine and holder match.

There are three magazines for 120 roll film: the A12 type made for 12 $2\frac{1}{4}$ in square (6×6 cm) images, the magazine A16 for 16 $2\frac{1}{4} \times 1\frac{5}{8}$ in (6×4.5 cm) images, and magazine A16S for 16 images in the Superslide size, 4×4 cm. The magazines are identified by engravings on the winding crank side. On magazine 16S, only the number 16 is engraved on the top exactly as on magazine 16; the S is on the bottom near the frame counter.

The different format magazines can, of course, also be distinguished by removing the dark slide. The format cut-out is then clearly visible. The magazines 16 and 16S are supplied with a transparent mask that is placed over the ground-glass screen to show the smaller areas covered by these magazines. The checked screen with microprism can be used instead of these masks as the lines engraved on the screen also correspond to the 16 and 16S formats.

One magazine, A24 (engraved 24), is made for size 220 roll film which has the same dimensions as 120 and is supplied on identical spools. It has short strips of paper at the beginning and end of the roll to protect the film when

loading and unloading, but no paper backing along the entire length of film. As a result, twice as much film can be put on the same size roll. This is the main advantage of 220—24 $2\frac{1}{4}$ in square images on one roll of film with a magazine identical in size to those made for 120 roll film.

While the magazine for 220 roll film looks identical to the 120 type from the outside, it differs in the gear mechanism and the springs on the pressure plate. The latter is necessary to ensure maximum film flatness since 220 film is only about half as thick as the combined film and paper of the 120 type.

Cleanliness is important in film magazines. Remove any dust and dirt particles in the magazines as these can easily scratch the film. Never place magzines, and especially roll holders, in dusty places. Before dropping the loaded holder in the magazine, have a look inside the shell to ascertain that there are no leftover paper pieces from the previous roll. The gummed pieces that are used to fasten the film end or beginning to the roll occasionally come off and could easily end up inside the magazine. Always remove the paper that is used to tape the beginning of a roll before placing the film on the holder. Never leave any loose paper on a roll of film. It can easily come off and possibly lodge itself in the film gate. Keep the openings of the connecting gear and pin free from dust, which may enter the magazine's winding mechanism.

Film identification

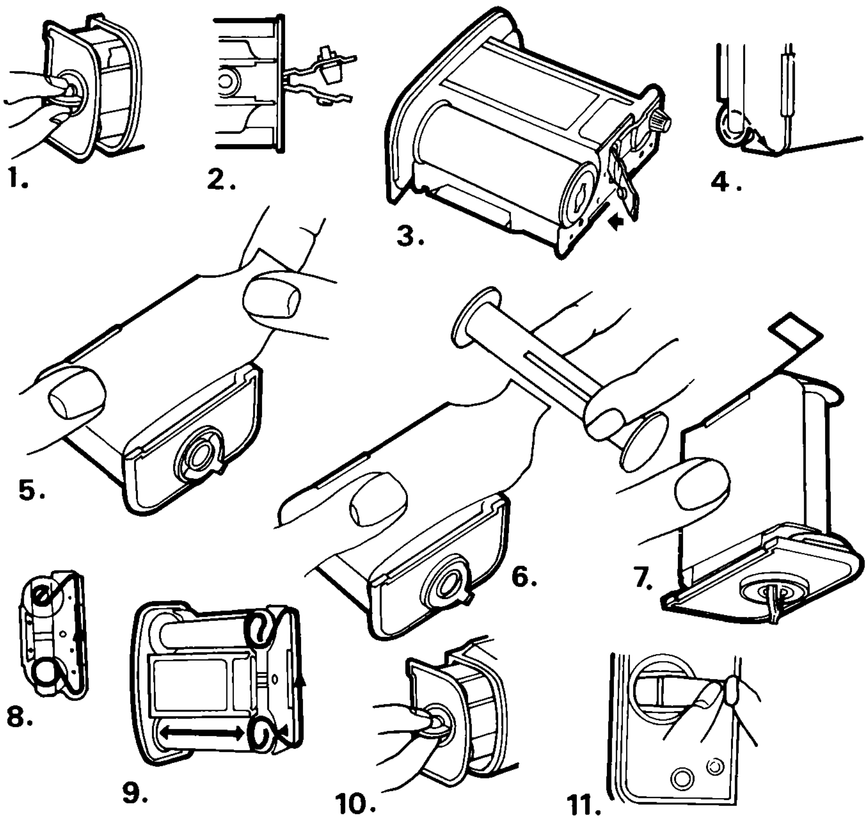
When using different types of film, it is necessary to know which film is in which magazine. This can be done neatly with the film indicator at the rear of the magazine. The sensitivity of the film can be dialed by turning the inside serrated disc until the correct ASA and DIN rating appears in the windows. The type of film is indicated by placing the top from the film box underneath the black cover disc.

Operating signals

Whenever the roll holder is taken out of the magazine shell, with or without film, the frame counter jumps to O and the operating signal in the magazine becomes black. The chrome strip, that keeps the film tight on the loaded spool, presses against a lever that activates the film consumption indicator on the roll holder lock. With a full roll, the indicator shows all white. As the film is used, more and more red shows in the circular windows.

Loading the magazines

The magazine for 220 film and all 120 roll film magazines are loaded in identical fashion. The paper protects the film from daylight, but it is best to avoid direct sunlight whenever that is possible. Use your own shadow if there is no other shade.



Loading the magazine

1 Fold out the magazine slide lock, turn it counter-clockwise and pull the film insert from the magazine.

Open both spoolholder arms (**2**). Place the roll of film on right side (**3**) and fold down the spool holding arm. The film unwinds as shown in **4**.

5 With the black pressure plate facing you, turn the magazine slide lock to its original position thus releasing the pressure plate.

6 Slide the beginning of the film with your thumb across the black pressure plate and underneath the guide at the upper part of the magazine so that 5–7 cm of paper extend.

Slide the film spool over the leader paper so that the beginning of the paper goes into the slot on the spool and make at least one full turn.

Place the take-up spool in the spindle (**7**) and flip down the spool holder arm with the knurled knob. The film should be wound up in the direction shown as the knurled knob can be turned in one direction only (**8**).

Turn the knurled knob until the black arrow on the paper is opposite the red triangular index (**9**).

10 Turn the insert lock counter-clockwise to lock the paper under the guide and then drop the spoolholder into magazine.

11 Turn the winding crank on magazine until it stops and there is a 1 in the frame counter window.

The non-automatic magazines are loaded the same way up to step 8 when the take-up spool is inserted into the spool holder. Make one turn on the knurled knob to ascertain that the film is firmly attached to the spool and insert the spoolholder in the magazine. Open the window at the rear of the magazine, turn the loading key until the 1 on the paper backing is centred in the window. Turn the key anti-clockwise to bring a 1 into the film counter window.

The simplest way to load a magazine is when it is attached to the camera and without the magazine slide in the magazine. It is possible however, to load detached magazines with their slides in. When loading, Hasselblad recommends placing the empty spool on the spindle before you attach the beginning of the film to the spool. When I change film, I hold the empty spool between my teeth until the film is under the side guide. Then, while my left thumb presses on the paper to keep the film under the guide, I slide the slot of the empty spool over the paper leader, make a turn and place the spool in the spindle. It is as well to straighten the paper lip a little so that the slot of the spool glides right over it. Make certain the film comes off the spool so that the black side is outermost, then the film faces the lens. Make certain the film rides *under* the side guide, not over it. For proper spacing, the images on every roll of film must start at the same place, which is the reason the black arrow must be placed opposite the red triangle. If this is not done, the spacing will be uneven and a shot may even be lost. Most films have only one black line—a black arrow going across the paper backing. The paper on some 220 films has first a black dotted line followed by the unbroken line with arrows a few inches later. Advance the film to the line with arrow. If you place the dotted line opposite the red triangle, two shots are lost.

With the film lined up properly, put the roll holder in the magazine and turn the film winding crank, until it stops. This moves the paper leader through the magazine so the first image is recorded on the film approximately 20 mm from the beginning of the film. The film winding crank also brings the number 1 automatically into the film counter window. The crank is locked at this point, and only at this point. After the first exposure, the film winding crank can be turned again to number 2.

Unloading

After the last picture on a roll has been taken, the camera's winding knob or crank can be turned as before so that there is no real indication that the end of the roll has been reached unless the release button is depressed but will no longer go down. I have, however, found that the turning of the knob or crank, and the sound of the film moving through the magazine, is just a little different when going from the second-to-last to the last frame (from 11 to 12 on magazine A12) from its normal sound. There is a little unevenness, a little resistance (combined with a change in sound) towards the end of the turn. I have become accustomed to the difference in sound and can now judge when the film is moved to the last frame without checking the frame counter.

At the end of a roll of film, the film winding crank is turned again to pull the paper trailer through the magazine and around the exposed roll of film so that it can be removed in daylight. When the paper has gone through, turning the crank becomes just a little easier.

It is advisable to wind the paper through immediately at the end of the

film, even if the magazine is not to be reloaded immediately. It is possible in this way to remove the roll holder at any time without wasting film. It is easy to forget such things and pulling out the insert without the paper wound up ruins at least the last two shots.

Spacing

With the film properly loaded, all Hasselblad magazines should space images pretty evenly from the first to the last picture. There are slight variations but the space between images should never exceed about 6 mm and should always be large enough to make a cut at the frame line and leave a little black area on each image. Proper spacing is determined by the accurate placement of the arrow next to the red triangle and making certain that the film is tight from spool to spool. If spacing is still not correct, there is probably a worn part in the magazine.

Spacing can be checked at any time by exposing a roll of film and developing it. It can also be checked without developing the film. Load a magazine with a roll of film, perhaps an old outdated roll. After the film winding crank is turned to 1, remove the magazine from the camera, remove the magazine slide and mark the image area on film, by moving a pencil around the magazine frame. Attach the magazine to the camera, take a picture, advance to 2, remove the magazine and draw the image area for frame 2. Proceed in this way to the last frame. The result is an unexposed film that has all the would-be exposed areas drawn accurately on it. The same roll of film can be reused for other magazines. Use a different colour pencil so that the marks are not confusing.

The non-automatic magazines

The film magazines that have been manufactured since 1969 are known as the automatic type and listed as A12, A24, A16 and A16S, although the A is not engraved on the magazine. The engravings are identical on the old and new types. A positive way to identify old and new types is by looking on the exposure counter side of the magazine. The automatic types have a black, foldable film winding crank. The non-automatic types have a chrome winding key occasionally covered by a black accessory crank which, however, is not foldable. Most, but not all, automatic types have in the rear the already-described, almost square, cover with windows to show ASA and DIN film speeds, which, when opened, reveals nothing but a spring steel plate.

The older non-automatic types have a round cover engraved with film speed and type. Underneath the cover is an opening which goes through the magazine to the film plane. This complete film type indicator can be set to show ASA and DIN film sensitivities as well as a symbol for the type of film in the camera. The engraved symbols are: a sun for daylight film; a lightbulb

for Tungsten type; a plus sign for positive (transparency) film; and a minus sign for colour negative film. There is also a partially white and black disc for black-and-white film.

Loading non-automatic magazines

Non-automatic magazines are loaded in the same way as automatic ones. However, the film need not be advanced to a specific point, so the older roll holders do not have the red triangular index. It is best to make at least two turns with the knurled knob to be sure that the film is firmly attached.

The roll holder is simply placed in the magazine shell and the film is advanced to 1 by opening the rear cover and watching the paper backing. Then make a counter clockwise turn on the film winding knob. This sets the frame counter to 1.

The older magazines have one advantage, they allow thirteen $2\frac{1}{4}$ in square pictures on a roll of 120 film if required. To do this, do not wind the film completely to 1. Stop approximately 20 mm before. The exact distance should be determined on your own camera and magazine. Starting earlier records the first image right at the beginning of the film. After 12 is reached, flip the film wind crank counterclockwise to bring the frame counter to 1. Take one more picture. Picture 13 should still be completely on the usable film.

120 film in 220 magazines

Although the magazine for 120 roll film should only be used for 120 film and magazine A24 only for 220, emergencies come up occasionally when a photographer might like to use either 120 in a 220 magazine, or vice versa. Here is what is possible and practical:

220 film cannot be used in an automatic A12, A16 or A16S magazine. The frame counter cannot be reset without pulling out the roll holder. This can be done only in a darkroom and then it will reset to 0, not to 1. Resetting the frame counter is necessary to fill the film.

120 roll film can be used in an A24 magazine. The spacing, however, becomes somewhat wide towards the end of the roll but all 12 images still go on the film. The first image is very close to the paper leader. To place it a little further away, move the black line with arrows about 5 mm past the red index. Although the A24 magazine is not designed for utmost quality with 120 film, the images are satisfactory for anything except the most critical work.

220 film can be used in nonautomatic magazines A12, A16 and A16S. This was done extensively when 220 film first came on the market. For a while, the A24 magazine was not available so photographers were forced to find other solutions. For this purpose, the magazine must first be made light tight, by closing the opening at the rear as there is no paper to protect the film. The easiest way is by using the Hasselblad light-tight plug. The opening can also be taped over with black opaque tape.

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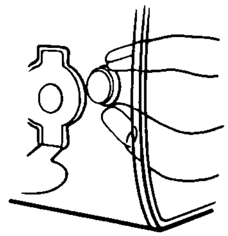
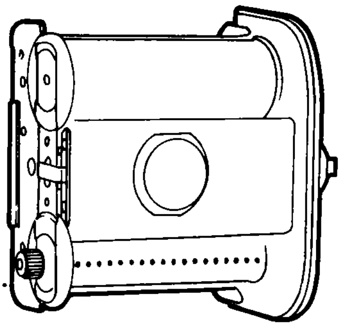
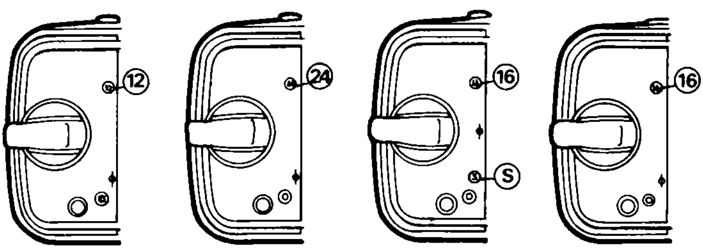
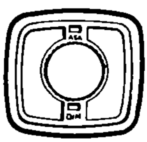


2.

When 220 film is used in non-automatic magazines—12, 16, or A6S, the back window must be closed with the light-tight plug or opaque black tape. The film is wound up until the dotted black line on the paper leader is opposite the red triangular index.



3.

The rollfilm magazines are engraved (**3**): 12 for 120 rollfilm and 12 6 × 6 pictures, 24 for 220 rollfilm and 24 6 × 6 pictures, 16 for 120 rollfilm and 16 $4\frac{1}{2} \times 6$ pictures, and 16S for 120 rollfilm and 16 images in Superslide size. Note that magazines 16 and 16S can be distinguished only by the S at the bottom.



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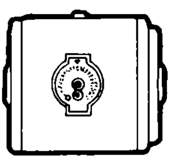
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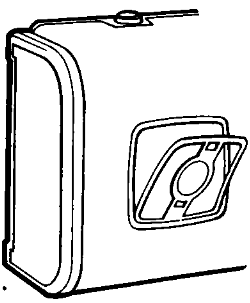

6.


7.

On the film type indicator of the automatic magazines, the ASA or DIN film sensitivity is set by rotating the serrated ring (**4**) after the cover has been flipped open (**6**). The tab from the film box can be placed underneath the cover to identify the film (**7**).

The older round film speed indicator (**5**) is set by turning the disc until the film speed number is opposite index. Turning the centre knob brings different symbols to indicate film type into the window: the sun is for daylight film, the lightbulb for tungsten, (+) stands for positive (transparency) film, (−) for negative colour, and the black and white disc for black and white film.

The spacing between images is not perfect but satisfactory, without overlapping or excessively wide frame lines, if the following loading procedures are followed. The actual loading of the film onto the spool holder is the same as described before. After the film is attached to the take up spool, turn the knurled knob until the first *dotted* line on the paper leader is in the centre of the receiving spool. The procedure from here on varies depending on the serial number of the magazine.

Magazine construction I: Magazines 12001–19999. (Note: these magazines were made for 1600F and 1000F cameras and cannot be used on 500C, 500EL, SWC and 2000FC cameras.) Place the roll holder in the magazine and set exposure counter to 1. Wind the film forward by making seven complete turns on the magazine winding crank. Expose 12 images (there is no stop). Reset frame counter to 1 with a counter-clockwise turn. Expose another 12 images.

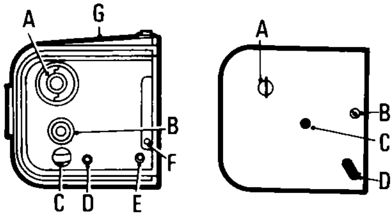
Magazine construction II: Magazine 12 Serial Number 20000–64399. Magazine 16 and 16S Serial Number below 204200. Place roll holder in magazine and set frame counter to 1. Wind film forward with 10 complete turns on the magazine film winding crank or until the number 8 begins to appear in the window. Reset exposure counter to 1. Expose 12 frames (16 on magazine 16 and 16S). Reset the exposure counter to 1. Expose another 12 images (16 on magazine 16 and 16S).

Magazine construction III: Magazine 12 Serial Number 64400 and higher. Magazine 16 and 16S Serial Number 204200 and higher. After placing roll holder in magazine, set frame counter to 1. Wind film forward by making nine complete turns or until 7 appears in the frame counter window. Reset frame counter to 1. Expose 12 images (16 on magazine 16 and 16S). Reset counter to 1. Expose another 12 images (16 on magazine 16 and 16S).

Magazine 70 has a serial number in the usual place on the front plate. The last three digits of this number are also engraved on the film insert between the two spool spindles. The basic design and operation of magazine 70 is identical to the other magazines. The image size produced on 70 mm film is exactly the same as magazine A12 or A24, 54 × 54 mm.

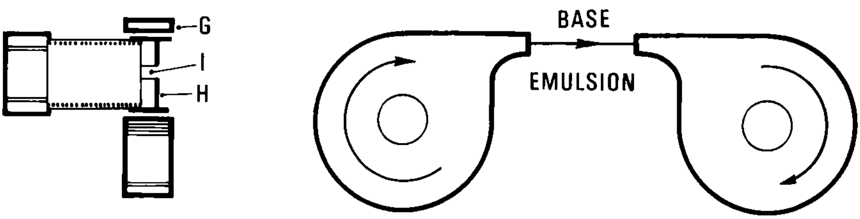
The magazine 70 has, however, two operating signals, the same one found in all other magazines near the film plane indicator which shows whether the film has been advanced, and a second one near the exposure counter which shows whether the magazine is loaded with film. The signal is connected to a lever inside the magazine which, when loaded with film, rests against the film between the feed cassette and sprocket wheel. It is red without film and white when loaded. The main difference in operation is that a camera equipped with film magazine 70 operates only with film in the magazine or when the feeler lever is taped in the down position. (This should be done only for demonstration purposes.) Without film in the magazine, the release is locked.

The film is advanced to 1 with a foldable winding key rather than a

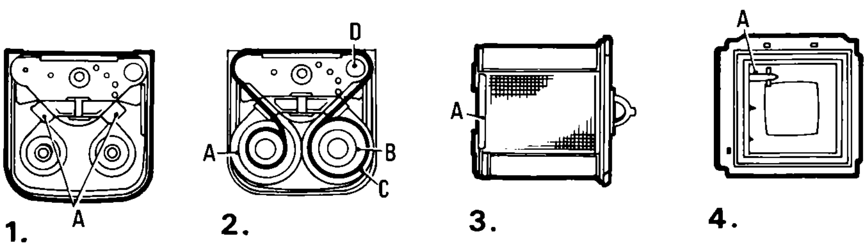


The 70 mm magazine
On the side of the magazine (left) are: the film transport key (A); the film counter setting button (B); the film counter (C); signal (D) indicating whether the magazine is loaded (white) or not loaded or at end of film (red); the operating signal (E); the film plane mark (F); and, a panel for notes (G).

When the cassette holder is pulled out, on the inside of the magazine (right) can be seen: the film winding shaft (A) with pin which connects to the film transport key; slotted pin (B) which locks the cassette holder to the magazine; the pin (C) connecting to the exposure counter; and, the feeler lever (D) which connects to the film load indicator. The camera can only operate when the lever is pushed down by the film or manually.



To attach the film to the take-up cassette, remove the cover (G) and spool. Insert the beginning of the film in the spool slot and hold it there with the retaining clip, if necessary taping it down as well. Wind the film once or twice around the spool *emulsion side inwards* and place the spool in the cassette so that it unwinds in the correct direction.



Loading the magazine
The cassette holder is removed from the magazine shell in the same way as the roll film holders from the other magazines. Open the cassette holding arms (**1**A). Place the feed cassette (**2**B) on the side of the magazine without the winding pin making sure that it unwinds in the right direction. Close the cassette holding arm. Guide the film (**2**C) round the sprocket wheel (**2**D), over the pressure plate and under the film clamp (**3**A). Attach the take-up cassette (**2**A) to the other side of the magazine, if necessary turning the winding key to match the pin (**4**A) with the slot in the spool. If the film runs smoothly, close the holding arm. Place the cassette holder in the magazine and check that the film runs through the channel and underneath the clamp.

Turn the film winding key until it stops when the counter should show 1.

handle. The magazine has two exposure counters. One is numbered from 1 to 73. The other is above the counter window, an engraved circle with knurled centre knob. This is a summarizing counter which can easily be seen from the distance. Each engraved dot on the circle corresponds to 10 images. Both counters return to the original position—to O or to the red line—when the cassette holder is removed. The return is activated by the little pin above the film feeder. Both counters can be manually reset by turning the centre knurled disc with the thumb.

This is done to allow the photographer to cut the film, process the exposed portion, and use the rest without losing track of the number of images. For instance, if you want to remove and develop a film with 23 images, after the 23rd picture, wind the exposed film completely inside the cassette by turning the film winding crank for three full turns. Remove the cassette holder and cut the film. Remove the film from the cassette in a darkroom. Reload the magazine in the ordinary fashion and wind the film to 1. Now reset the exposure counters manually to the number of images that have been removed, adding 4 for the probable amount of film that has been lost in cutting. If 23 exposures have been made, set the counters to 27. The type of film in the magazine can be indicated at the rear as on the other magazines, or can be written with pencil on the tablet on top of the magazine. The tablet can naturally be used for any other notations.

70 mm film

70 mm film can be either unperforated, or perforated in various different ways. The Hasselblad magazine 70 takes *perforated type II*. This is the only film that works. Some film is available in daylight-loading cassettes (Kodak code is 488). Other emulsions are purchased in bulk, usually 100 ft spools, for loading your own cassettes (Kodak code is 475). It is not necessary to fill the spool. Insert any amount of film up to 15 ft (450 cm), keeping in mind that 1 ft (30 cm) of film holds 5 images, not counting the necessary leader and trailer.

The cassettes are loaded in a darkroom. Wind the film manually on to the spool, filling it almost, but not quite, to the diameter of the flanges for a full load for 70 exposures. There are film loaders available which simplify the job. Some loaders even permit loading cassettes in daylight, as the bulk film and the cassette go into separate light-tight chambers. The only operation that must be done in darkness is the placing of the bulk film into its chamber.

Any damage to the film in loading must be prevented. Wind the film as tight as possible from the beginning so that it is unnecessary to tighten it by pulling the film.

70 mm cassettes

70 mm cassettes are similar to those used in 35 mm cameras. The covers on either side are removable so the spools can be removed for loading and un-

loading. The spools can be inserted either way, but the film must move in and out of the cassette so that it follows in a straight line from the opening, with the emulsion side towards the centre of the cassette. The cassettes are made light-tight by a felt covering where the film comes out. Needless to say, the felt portion must be kept absolutely clean as the film rides over both sides. Dirt particles can easily scratch the film. There is also a certain amount of wear on the felt, and frequent opening and closing of the cassette can deform the seal. Cassettes, just like those in 35 mm cameras, are not made for indefinite use. To avoid possible problems, they should be treated very carefully, and preferably be discarded after 4 or 5 uses. They may last much longer if treated properly. Every roll of film should be carefully examined after processing for possible light leaks and both sides, base and emulsion, carefully checked for scratches. If neither leaks nor scratches are present, reuse the cassette.

When sending the film out for processing, make certain the laboratory returns the spool and cassette to you so that they can be used again. Also, select a laboratory that is equipped to process the 15 ft lengths without need of cutting. Tanks holding 15 ft lengths for home processing are also available.

Loading magazine 70

The cassette holder is removed from the magazine and inserted in the same way as the roll holder of the other magazines. The loading procedure also follows basically the same lines except that cassettes instead of rolls are placed on the two spindles. The two most important points that require special attention are placing the film underneath the side clamp and attaching it firmly to the spool inside the cassette. The spools in some cassettes have a slot, others do not but have a locking spring clip around the core. Place the beginning of the film in the slot or lock it to the case with the metal clamp, or do both.

While both methods usually hold the film without coming loose, as an extra safety precaution tape the film in addition to the core using a good masking or plastic tape. Wind the film once or twice around the core before you insert the spool with film into the cassette. Make certain that the cassettes go on the proper spindle, the full cassette on the side with the sprocket wheel, the empty one on the side with the film winding shaft with pin.

Special purpose magazines

Magazine 70/500. In some fields of photography, such as aerial and surveyance work or school photography, changing of film or magazine is impractical or impossible. When this is the case, and more than 75 exposures must be made, the magazine 70/500 can be combined with Hasselblad 500C/M, 500EL/M, SWC and 2000FC cameras.

The magazine takes the same type 2 perforated 70 mm film that is used

in magazine 70 but it can be loaded with as much as 100 ft of film. This provides from 485 to 535 exposures on a roll of film. The exact number depends on the thickness of the film. It can be loaded with smaller lengths, or the exposed portion can be cut with a built-in knife, and the rest used at a later date.

The film must be wound on what is known as Kodak standard S84 spool. It must be darkroom loaded. The image size is 54 × 54 mm. The magazine 70/500 takes the same magazine slide and is attached to the camera in the same way as the other roll film magazines, by depressing the lock button above the magazine slide opening. The magazine slide can be stored in a slot at the rear of the magazine. It also stops operating when it reaches the end of the film.

Film transport. As it takes considerably more power to pull 100 ft of film than the regular roll film length, the film in the magazine 70/500 is transported by a motordrive powered by a 6V battery. The battery is the type as used in the 500EL/M camera and is therefore recharged in the 500EL/M camera with either one of the Hasselblad recharge units. A fully charged battery is good for at least 500 exposures. An EL/M camera equipped with magazine 70/500 can take pictures at the rate of approximately 70 images per minute. At the beginning of a roll, it is somewhat slower as it takes more time to roll the film on an empty spool. As the spool diameter becomes larger, the shooting rate becomes faster. The magazine battery is in a compartment which is removed by turning the large round locking cover counter clockwise with a coin. The battery fits in the compartment only one way, the right way, so mistakes are eliminated.

Film counters. The magazine has two film counters—each can be reset to zero at any time independently of the other. One counter, for instance, can be set to show total number of exposures, the other, the number of exposures after a film has been cut.

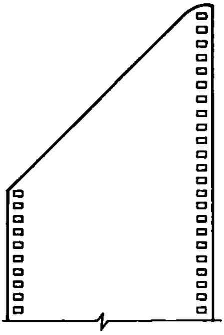
Film cutting. To cut partially exposed film, advance the film two frames so that the exposed portion moves past the cutting point which is above the film gate. Since the film moves from bottom to top, the exposed film is in the top chamber and must be removed in the darkroom.

The unexposed portion of the film can be left in the bottom feed chamber. If left there, the beginning of the unexposed film can be attached to the film-spool in bright daylight, as there is no need to open the bottom feed compartment.

Magazine 70/100–200. This darkroom-loaded magazine accepts spools taking 100 exposures on ordinary film or up to 200 exposures on Estar-base material per loading, depending on emulsion thickness.

Magazines for Polaroid film. The application and operation of Polaroid film magazines is described in the chapter on instant photography—page 223.

Cut film adapter and film holder. The Hasselblad cut film adapter and cut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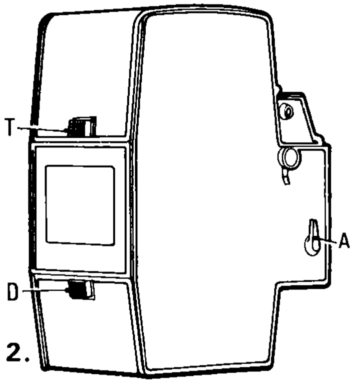

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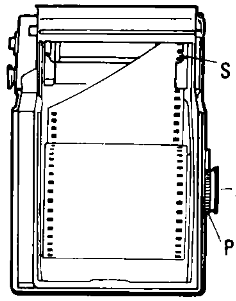

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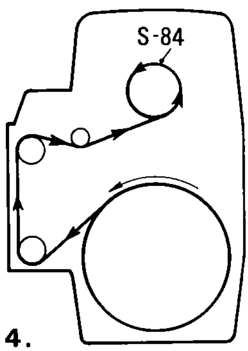

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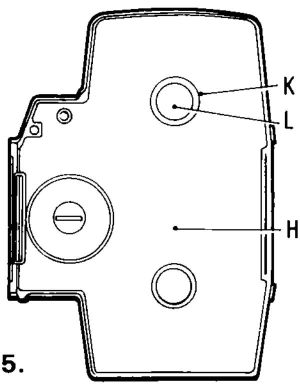

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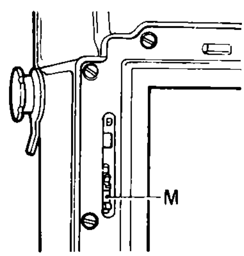

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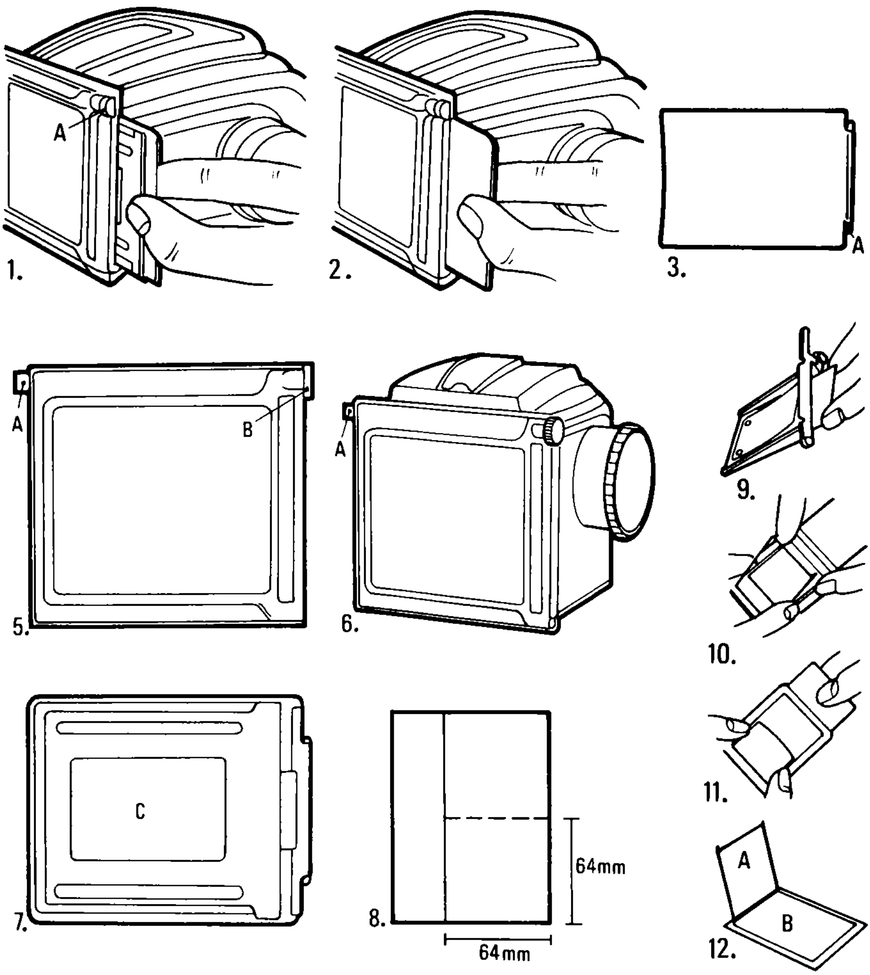
Loading the magazine 70/500

As the 70 mm film on 100 ft (30 m) spools is not protected from light, the first part of the loading procedure must be done in the darkroom. Cut the beginning of the film at a 45° angle (**1**). Open the cover of the feed compartment (lower compartment) by pushing button D (**2**) to the left and pressing the cover forward and up. **3** Turn knob P a quarter of a turn counter-clockwise and pull out button R. Place the feed spool in the compartment. Turn knob P clockwise to attach the spool to the spindle. Push the film into the film guides with sprocket wheel (S) engaged in the perforations. Advance film by rotating the sprocket wheel and carefully press the pressure plate until the film appears in the film gate. Advance the film by pushing it until it reaches the sprocket wheel at the other side of the film gate. Close the cover of the film feed chamber. The rest of the loading procedure can be done in daylight.

Push the film approximately 6 in into take-up chamber. Turn magazine the right way up and open take-up chamber by pushing knob (**2**T). Insert magazine darkslide. Attach film firmly to an empty S-84 spool (**4**) to follow the illustrated path. If the spool is not in the chamber, insert by turning the knob (**5**K) clockwise and pulling out button. Lock the spool on the spindle by turning knob K clockwise. Close the cover chamber (H) and attach the magazine to camera. If it does not attach easily, turn the connecting gear (**6**M) in the magazine until the sensing lever above the gear can be pushed in.

Camera and magazine are ready for photography. In case the magazine should not start, move arm A (**2**) forward.



Using the sheet film adapter
With the film holder removed, attach the adapter to the camera as for any other film magazine. Insert the sheet film holder until it is locked in place by the holder lock (**1**A). Remove the darkslide, make the exposure and insert the darkslide completely (**2**). Note that the handle of the darkslide has a red button (**3**A) that can be used as an exposure signal.

To remove the sheet film holder (**5**), turn the holder lock (B) slightly and pull out the holder by the handle. To remove the adapter from the camera, press the adapter lock (**6**A). The type of film or other notes can be written in pencil on the white area of the film holder (**7**C).

Loading the sheet film adapter
Cut a piece of film 64 × 64 mm from a larger sheet (**8**) or, using the Hasselblad film cutter, cut the larger sheet into a 64 mm strip, insert in the cutter and slice (**9**). Insert the suare film sheet underneath the frame of the film holder with the emulsion side upwards (**10**). Press the frame down to insert the darkslide (**11**).

12 Glass plates can be used after removing the pressure plate (B) by sliding it away from the film frame (A). Insert the plate in the same way as sheet film.

film holders are used like sheet film holders in a view camera. This allows the use of special emulsions, such as orthochromatic and high contrast copy films, special duplicating films and films for scientific photography. It also allows each shot to be developed to individual requirements. Glass plates of proper size can also be used by removing the pressure plate in the cut film holder.

The cut film adapter attaches to all Hasselblad models like the roll film magazines, but it does not have a magazine slide. The dark slide is part of each cut film holder.

The adapter, however, has the usual features that prevent mistakes. It cannot be attached or removed from the camera when the cut film holder is inserted. Exposures can be made only when the darkslide is removed completely.

The image size on the film is the standard 54 × 54 mm square. The size of the actual film loaded into the cut film holders must be 64 × 64 mm ($2\frac{1}{2}$ × $2\frac{1}{2}$ in). It is cut from any sheet film 64 mm ($2\frac{1}{2}$ in) or larger. $2\frac{1}{2}$ × $3\frac{1}{2}$ in sheets are ideal. The Hasselblad scissors cut a piece of film that is already 64 mm ($2\frac{1}{2}$ in) wide to the proper 64 mm length. To do this, place the film under the flap so it touches the two top plates. If a larger size must be used, cut a 64 mm wide strip first with regular scissors or a paper cutter.

Loading the cut film holder. In complete darkness, or the safelight specified for that film, place the film in the film frame on the pressure plate; underneath the frame with the emulsion side facing the frame. Fold the frame down and press the forward frame edge down enough to permit complete insertion of the darkslide.

Insert the darkslide so that the white button at one end of the slide is to the left of the Hasselblad nameplate (as seen from back of film holder). On the camera, the white button is on top indicating that the film is unexposed. Loading should naturally be practiced in daylight with a piece of paper or dummy film.

Using cut film. With the adapter attached to the camera, insert the film holder until it is locked by the lock. Remove the darkslide completely to make an exposure. Reinsert the dark slide so that the red button is now on top indicating that the film is exposed; turn the film holder lock to remove the cut film holder. The adapter is removed from the camera by depressing the side release.

6

Operating the 500EL/M

Motordrive

The Hasselblad 500EL/M is designed, as the other models, for holding in the left hand with the index finger on the front release.

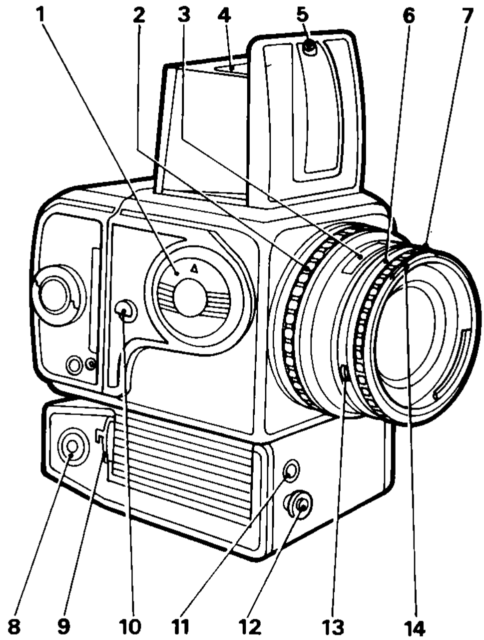
The battery compartment cover is removed by inserting a coin or the Hasselblad key disc in the slot of the cover lock. Rotate the lock a quarter turn, counter-clockwise, so that the slot is vertical. The cover should now come off. Inside the battery compartment, the motordrive is at the rear and there are two large openings for one or two batteries. There are also four small openings, the one above the motordrive probably filled with a fuse; the other three openings can be used to store spare fuses. The fuse and the battery, or batteries, drop out of their compartments when the camera is tilted. The fuse is a 1.6A medium slow-blow fuse, 5 × 20 mm in size. Only this type is to be used. The battery is a rechargeable DEAC 5/500 DKZ nickel cadmium consisting of five connected 1.25V cells for a total 6.25V. Its size is about 35 × 50 mm.

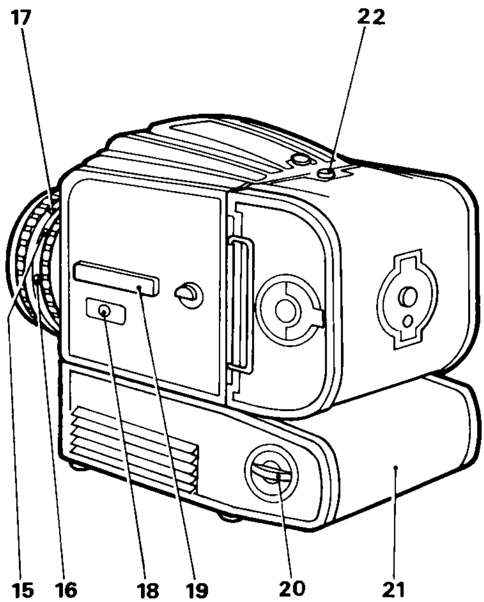
Only one battery is necessary to drive the camera, and it can be inserted in either opening. A fully charged battery should last for about 1000 exposures at normal temperature. It is also possible to insert two batteries, when the camera works in exactly the same fashion but will give twice as many exposures, approximately 2000. If two batteries are used, both discharge simultaneously, not sequentially.

Using only one battery makes the camera as light as possible; the second charged battery can be kept as a spare in the case. This method is particularly recommended for working in cold weather when the capacity of nickel cadmium batteries drops. So, rather than letting both batteries get cold in the camera compartment, keep the spare battery in a warm place if possible.

The batteries are slightly conical to ensure that they are inserted properly in the compartment. The narrow end, marked (+), should go in first. If inserted correctly, the battery rests against the spring in the compartment and this pressure can be felt when the battery is pressed in. The battery does fit

The Hasselblad 500EL/M





1 Selector dial.
2 Focusing mount.
3 Depth of field indicator.
4 Magnifier in focusing hood.
5 Opening catch of focusing hood.
6 Shutter speed scale.
7 Shutter speed setting ring.
8 Release socket.
9 Time exposure lever.
10 Fitting for carrying strap.
11 Front release sockets.
12 Release button (removable).
13 Finger hold for exposure value setting.
14 Filter mount.
15 Synchronizing lever.
16 Synchronizing lock.
17 Flash contact.
18 Flash cable socket.
19 Rail for sports finder.
20 Opening latch of battery case.
21 Battery case.
22 Magazine latch.

into the compartment the other way, but it rests against the compartment wall, not the spring. If the battery has been inserted incorrectly the compartment cover will not lock.

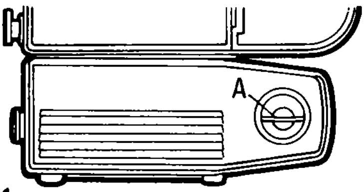
If nothing happens when the release is depressed, check first that the locking lever on the side of the battery compartment is at O (not in the locked L position), then check that the magazine slide has been removed and that the exposure counter in the magazine has not reached the end of the roll, or, in the case of the magazine 70, that there is film in the magazine. If any of these checks do not make the camera work, check the fuse. A blown fuse usually indicates that something is wrong in the electrical circuit, and, changing the fuse may not solve the problem. If the fuse is still good, there is only one more item to check—the battery.

Battery facts

Regular nonrechargeable batteries (dry-cell batteries) lose their charge gradually. The state of charge, the remaining capacity, can easily be checked with a meter. Rechargeable nickel cadmium batteries keep their capacity at an almost even level to the end of their life. Then, the power drops suddenly and rapidly in the case of the 500EL/M, with capacity for only a few exposures left in the battery. The state of charge of a nickel cadmium battery therefore cannot be tested. The only way to keep a check on it is by a rule of thumb based on the number of exposures. It is therefore recommended to keep some kind of record, written or mental, on the number of exposures made.

A discharged battery requires 14 hours charging time to become fully charged, that is, capable of producing 1000 exposures. Using this as a guideline, a battery should be charged for one full hour for every 72 exposures made, regardless of whether one or two batteries were used in the camera. This time is based on more or less normal temperatures. In cold weather, a somewhat longer charge is required. This charging time is based on the assumption that the battery was fully charged at the start. If the battery was charged sometime before and then stored, the so-called shelf life must also be considered. A charged Hasselblad nickel cadmium battery loses approximately 10% of its charge within the first 24 hours after charging is completed. After this initial loss, it retains 90% of the balance (81%) if stored without use over the period of the next three to four months. After this time, a 'topping' charge of five to seven hours restores full capacity to the battery.

It is said, however, that a nickel cadmium battery that is always discharged to approximately the same level and recharged for approximately the same length of time eventually 'forms a memory' so it no longer has the full capacity. It is, therefore, recommended to discharge the batteries completely and then expose them to a full 14 hour charge. They can be discharged in the camera by simply triggering the release without film in the camera until the cycle slows down or the camera stops completely. A better method,



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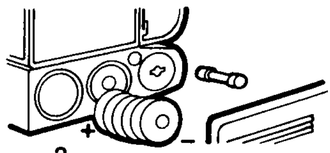

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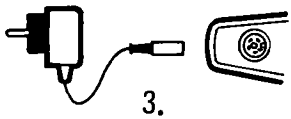
The battery compartment, at the bottom of the 500EL/M, is opened by a full clockwise turn of a coin inserted in the cover lock (**1**A). Inside (**2**) are two battery and four smaller compartments. If only one battery is used, it may be placed in either of the large compartments; the '+' end must face towards the camera. The smaller compartment above the motor at the rear carries the operating fuse; the other three can carry spare fuses.



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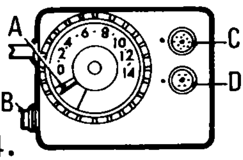
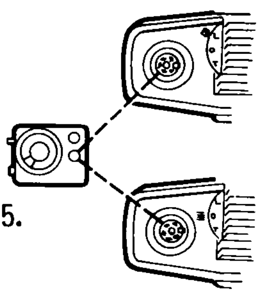


4.

The batteries are charged in the camera by connecting a charger to the outlet at the side of the battery compartment (**3**). The standard charger must be disconnected after the required charging time but the recharge unit 3 (**4**) will automatically switch off and supply a 10 mA trickle charge after a preset time. The camera is connected to the lower socket (D) whilst the upper socket (C) can be used to release the camera via the recharge unit with, for example, a release cable, timer or radio. The charger is started and set for the required number of charging hours by turning the transparent dial clockwise until the red marker (A) is opposite the correct number of hours. B is a 100 mA fuse.

On the newer cameras with a black locking lever, the camera can be charged at the end of a cycle with the lever at 'O' or 'L'; to charge in mid-cycle, the lever must be at 'L'. In older cameras with chrome locking lever, the batteries can only be charged when the camera has completed its cycle.



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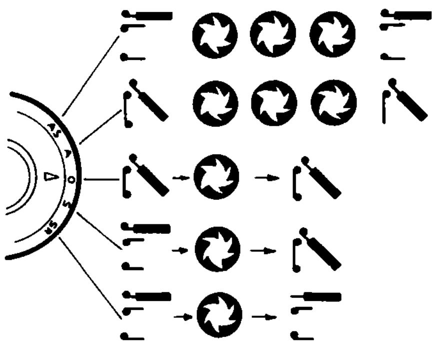


The operating selector dial

At the normal setting 'O', one picture is taken and the camera stops in the normal position with the mirror down.

At 'S', the camera is prereleased but stops in the normal position after the picture is made.

'SR' is also a prereleasing position but the camera stops in the prereleased mode with the mirror up after the picture is taken. 'A' is the automatic mode where the camera takes pictures at the rate of one a second as long as the release is depressed or as long as film is in the camera; the camera stops in normal mode. 'AS' is for automatic operation starting and ending in the prereleased mode; the camera operates somewhat faster than in the 'A' position—about 12 pictures in 9 seconds.

however, is to connect a 6 volt bulb with two connecting wires to either side of the battery (the wire can be taped on) and wait until the light starts to fade.

If the battery, or batteries, in the EL/M camera are also used to operate other Hasselblad accessories, radio control or the lenses with automatic diaphragm control, their power consumption must be considered and is calculated as follows. The radio receiver draws little power and can operate for approximately 50 hours on one fully charged battery, and 100 hours from two batteries. This means that for every four hours of the radio receiver being turned on, the charging time is one hour, regardless of whether one or two batteries are in the camera. This time is added to the required charging time based on the number of exposures made.

With the automatic aperture lenses, the calculation can never be too accurate as the power consumption is much higher during the time the servo motor actually opens and closes the diaphragm. So, somehow an account must be kept of how much of the time the diaphragm actually was in operation. If the light remained pretty much the same or changed gradually, as during sunrise and sunset, power consumption can be assumed to be a minimum. If, however, the light was constantly changing, during a stage performance perhaps, the servo motor drains the battery more rapidly. When used for the automatic diaphragm control only, each fully charged battery lasts approximately 30 hours in stand-by operation with a minimum change in the aperture and approximately 10 hours when in continuous operation with a frequent aperture change. With two batteries in the camera, the hours can be doubled. The number of exposures that are made during this time must also be considered.

The batteries for the EL/M camera, are supplied in a partially charged state. The amount of charge depends on the length of storage time in the warehouse or store. In any case, it is recommended to charge each for approximately five hours before the camera is used. So that you know what the state of the charge is, use the battery or batteries until the rewinding of the camera really slows down which is a good indication that the battery is close to the end of its charge. Recharge the battery for the full cycle.

Battery charging

It is necessary to know as accurately as possible how much charge the battery needs. No harm is done if it is *undercharged;* there will simply be less than 1000 exposures from each battery. All nickel cadmium batteries, however, can be easily damaged through excessive *overcharging*. A battery that is charged twice as long as required, permanently loses about 10% of its capacity. A fully charged battery then yields only 900 exposures. This in itself is not too serious. If the overcharging, however, exceeds the above times, or if the battery is overcharged many times, it changes shape—its top and bottom 'seals' begin

to bulge. A battery in this condition should be discarded. Otherwise, it may split open and the corrosive contents leak out into the camera.

A battery can also be damaged by using a charger which is not made for the specific type of battery. For this reason, only the chargers specifically made for the 500EL/M should be used.

The simple, inexpensive recharge unit I is supplied with the camera. It serves its purpose very well but it is important to unplug the unit when the charging time has elapsed. The unit continues charging as long as it is plugged into the outlet. Set some kind of an alarm if possible.

The recharge unit III, available as an accessory, has a built-in timer which can be set anywhere up to 14 hours. When the set time has elapsed, the timer automatically changes to a reduced 10 mA trickle charge. It eliminates the possibilities of overcharging and, for this reason alone, may be a worthwhile investment. The camera can be left connected to the timer and AC line. Treated properly, these nickel cadmium batteries can be recharged hundreds of times before they have to be replaced.

Using either one of the Hasselblad recharge units, each fully discharged battery must be recharged for 14 hours. If two batteries are recharged simultaneously, the total charging time is 28 hours.

The recharge unit III is made for either 220V 50Hz or 110V 60Hz. The fuse on the left side is rated at 100 A. It is connected to the camera by means of the 1.5 m (5 ft) connecting cord, LK 150, or the longer, 5 m (16 ft), LK 500, using the lower of the two sockets. With the recharge III unit connected to the camera, the camera is released with the 1.5 m (5 ft) release cord, SK 150, attached to the upper socket on the recharge unit.

Batteries may be recharged independently of the camera with a special accessory compartment.

AC operation

Besides the built-in timer, the recharge unit III also allows the operation of the EL/M camera while the recharge unit is connected to the camera and AC line. It, therefore, allows AC operation—operation without using the power from the battery—which is useful in studio work. For this purpose, at least one battery must be in the camera.

The need for batteries is eliminated with the power supply unit which consists of two components: a small transformer/rectifier box and a camera panel. The panel is a battery compartment cover with an outlet to make the necessary electrical connections in the camera. The batteries are removed and the panel is attached on the battery compartment in place of the cover. The 1 m (3 ft) cable from the power supply unit is connected to the outlet on the camera panel. The camera is ready to operate as soon as the power supply box is connected to the AC line. The connecting cable between the power supply unit and camera can be lengthened with the LK 150, or LK 500, connecting cords.

Camera controls for charging

When the battery is charged in a recent camera (with a black lock/charge lever) in the normal 'ready to shoot' position the lever may be either in the O or L position while charging. If, on the other hand, the camera stopped before completing its cycle, the lever must be in the L position, otherwise the battery does not charge. It is therefore best to always place the lever on L for charging.

On the older Hasselblad EL/M cameras (with chrome levers) battery charging in the camera is possible only when the camera has completed its cycle, i.e. the mirror is down. When this problem arises on the older cameras, the battery can be recharged outside the camera using the battery compartment, then inserted in the camera where it automatically completes the camera cycle. Another solution is to complete the camera's cycle so that the battery can be charged in the camera. If you have a second charged battery, the process is simple. If not, find a standard charged 1.5 V D-cell flashlight battery. Place it, with the (+) terminal first, in one of the battery openings in the camera. Hold the compartment cover over the battery to make contact with the fuse and the camera should complete the cycle. Now, insert the Hasselblad battery, close the cover and charge.

The operating selector dial

Of the five operating methods, two have already been discussed as they relate to prereleasing the camera. When set at O, one picture is taken in the normal fashion every time the release is depressed. The EL/M operates like the 500C/M except that the camera is automatically ready for the next shot after the exposure. When sequences of images are desired, settings A or AS are used. In both, the EL/M keeps taking pictures as long as the release is depressed and there is film in the camera. At A, pictures are taken at the rate of 1 picture per second and the camera stops in the normal position. When the control is moved to AS, the camera is prereleased and sequence operation is somewhat faster, about 12 images in 9 seconds. The camera stops in the prereleased mode. Fastest sequence operation is the main application for AS.

To put a camera in the normal viewing position after it stops, prereleased, at SR or AS, move the operating dial to O and push the release to take a picture. If you do not want to waste a frame of film, remove the magazine before depressing the release. The operating dial moves easily and, as it is not locked in a set position, can be moved accidentally for instance from O to A. If this should happen, you might take three pictures before realizing. It is therefore worth checking the operating dial position before releasing the camera. To avoid accidental moving of the dial, place a short piece of black electrical tape over it.

Releasing through the side socket

The side socket of the camera, which is used for connecting the charger, can also be used for releasing the camera. In this 5 pin socket, pins 1 and 3 are used for triggering the camera. Whenever the electrical circuit between 1 and 3 is closed, the camera takes one picture when set to O, S or SR, or takes pictures as long as the circuit is closed when set to A or AS. The circuit can be closed manually or automatically by an impulse from an instrument, a photocell when its lightbeam is cut, from a sound signal, etc. One photographer, for instance, has taken some rather well-publicized pictures of the faces of famous golfers the moment the ball was hit. The EL/M camera in this case was triggered by the amplified sound signal from the golf club hitting the ball.

Another photographer recorded most unusual images of night birds approaching a nest in complete darkness. The camera and electronic flash went off when the birds crossed the beam of a photocell near the nest. The external resistance used for triggering through pins 1 and 3 should not exceed 6 ohms.

Releasing with cables

For hand-releasing through the side socket the release cord SK 150 is used. It has a release button at one end and a five pin socket at the other end that is plugged into the side socket. For releasing from longer distances the release cord, SK 150, is extended by adding a connecting cord, either the LK 150 or the longer LK 500. For releasing from even greater distances, up to six 33 m (100 ft) connecting cords DK 3000 can be joined. Releasing by wire is possible from as far as 200 m (600 ft), but when the distance exceeds 33 m (100 ft) there is excessive power loss in the cable and amplification is required. A small, solid-state amplifier is used for this purpose and is connected between the camera and the first connecting cord.

The EL/M camera operates in the same way when released through the side socket as it does from the front release. The release must be kept depressed until the lens shutter closes—this is important to keep in mind at the longer shutter speeds from 1/4 sec to 1 sec.

Releasing EL/M cameras equipped with automatic aperture lenses

When the lenses with automatic aperture control are used on the EL/M, the power for driving the servo motor is taken from the camera batteries. The cable from the lenses is therefore connected to the side socket of the camera. There is no problem unless it is also necessary to release the camera through the side socket.

One solution is to use the multiple connector, which is a short cable with one connector at one end and two at the other. The end with one socket goes

into the camera; the cable from the automatic lens goes into one of the connectors at the other end while the second can be used for the release cord (or for connecting cords to intervalometers, radios or other triggering devices). When the connection is more than 33 m (100 ft) the amplifier goes between the multiple connector and the connecting cord.

A second solution is to operate the automatic diaphragm from a separate battery in the battery compartment attached to the camera's accessory rail. This arrangement is preferable when a large number of exposures are to be made and especially in situations where the diaphragm in the lens opens and closes frequently and therefore consumes much power.

When the automatic aperture control lenses are used, the camera can, of course, also be released through the front release button, or SK 150 release cord attached to the front release.

Releasing with radio

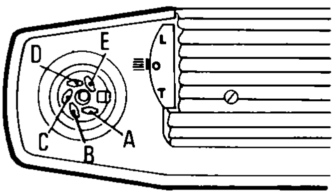
The signal to trigger the camera can be transmitted from a distance by means of a radio signal, if this complies with the law. This eliminates any wires between camera and operator. Basically any radio equipment designed for such purposes can be used with the Hasselblad EL/M. The signal, in the form of an electrical current from the radio receiver, must be guided to pins 1 and 3 in the side socket. Its external resistance should not exceed 6 ohms. Some radio units work on one specific FM wavelength, others have a choice of frequency bands.

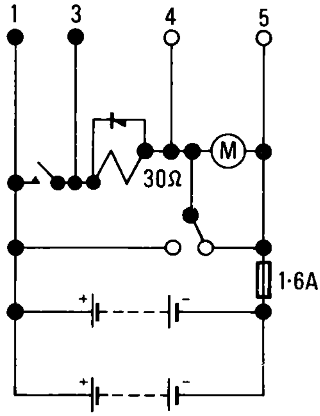
The Hasselblad radio unit works on the 27 MHz band, but the crystal that controls the frequency can be changed to operate on a different channel. This is necessary if other equipment in the same area is controlled by radio, or if another Hasselblad photographer is also using a radio release in the vicinity.

On the other hand, two or more cameras can be operated from one transmitter if the receivers on all cameras work on the same frequency. If multiple cameras are within relatively short distances, it is not necessary to equip each one with a radio receiver. Instead, one radio receiver is connected to the top socket on the command unit, and the cameras—up to four—are plugged into the sockets at the front of the command unit.

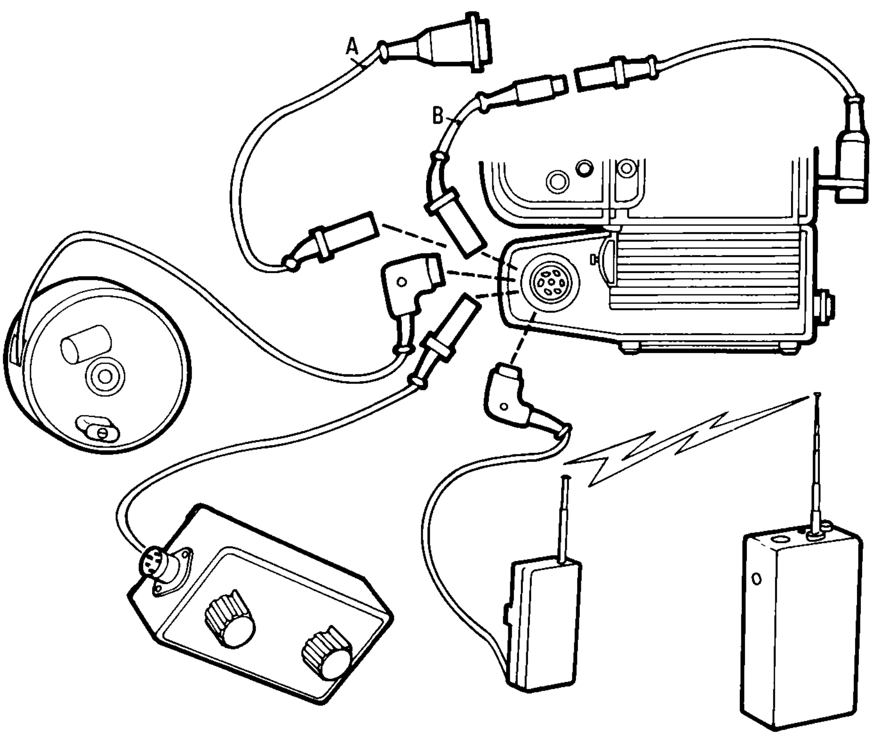
Having radio-controlled cameras triggered by spurious signals is their main problem. The use of FM makes the equipment rather insensitive to external interference. The Hasselblad transmitter emits a double signal when the release button is depressed. The receiver takes 0.2 sec to identify the transmitter signal, consequently there is a very slight delay in releasing the camera.

The distance range depends on the location and the weather. At unlimited visibility it should be at least 330 m (1000 ft). The advantage of radio control is therefore not the range, but the elimination of wires. Other more





The 500EL/M can be released by many external triggers connected to the camera at the outlet at the rear of the motor compartment. Pins A and C (corresponding to inputs 1 and 3 on the circuit) are used for releasing the camera. The exposure current is 0.2A, the circuit voltage 6V.



The camera can be released through the rear motor socket with the release cord SK 150 (A) alone, or through the LK extension cord (B), with the cord reel, intervalometer or radio release.

powerful radio equipment can work at greater distances. The radio receiver can be made part of the camera as it attaches to the accessory rail. The necessary power comes from the battery in the camera. The receiver consumes 20 mA as long as it is connected to the camera. The battery drain per hour is equal to that consumed for making 20 exposures. One battery should therefore last for about 50 hours if no pictures are made. Using the multiple connector, a recharge unit can be connected to the camera together with the radio receiver. Recharging times must be doubled when the connected radio is used.

The power to transmit the signal from the transmitter comes from eight AA penlight batteries in the transmitter. The condition of the batteries can be checked by depressing the release. The battery check lamp lights up when the batteries are in good condition. With the batteries in the transmitter and the antennae of the transmitter and receiver fully extended, the camera is released by pressing the release button on the transmitter. A red lamp lights up when transmission is in progress. Keep the release button depressed for 1/2 to 1 sec to ensure releasing because of the slight delay by the receiver in identifying the signal. When the camera is set for exposure times of 1 sec or longer, keep the release button depressed long enough for the shutter to complete the exposure time. There is not much drain on the transmitter batteries as only 200 mA is consumed when the release is depressed.

The SK 150 release cord, together with connecting cord LK 150, LK 500 or DK 3000, can be attached to the transmitter for remote releasing if necessary. The maximum length is 33 m (100 ft) as the amplifier cannot be used.

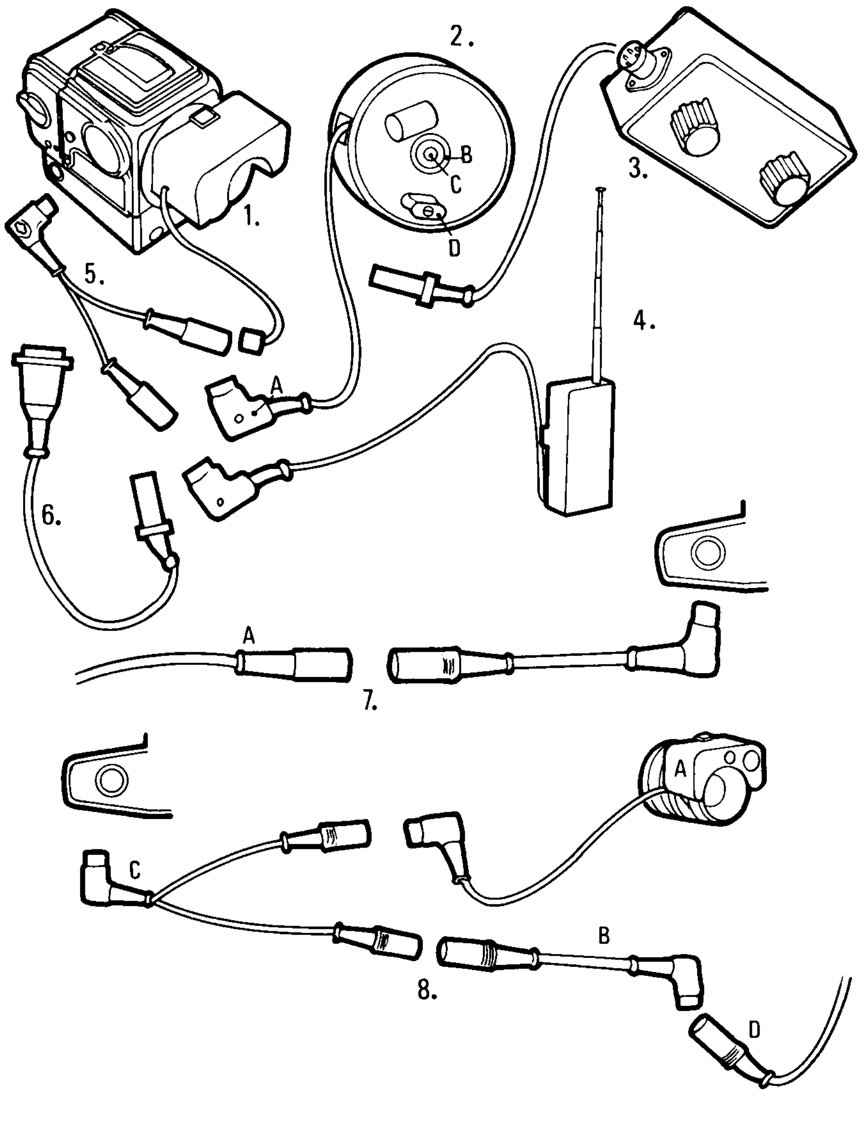
The Hasselblad radio equipment is made to operate at temperatures from −20°C to +60°C (4°F to 140°F).

Releasing from the intervalometer

An intervalometer is in principle nothing more than a timing device which gives an impulse at regular intervals (set on a dial) to trigger a camera or other device. Intervalometers for cameras are made by many different companies. Many are specifically for motion picture cameras as movie cameras are more often used for this type of work, called time-lapse studies. This, however, does not mean that they are not usable for motor-driven still cameras, including the Hasselblad EL/M. Check their signal specifications, keeping in mind that the external resistance should not exceed 6 ohms for the EL/M camera.

If the necessary time intervals range between 2 sec and 14 min, the Hasselblad intervalometer serves its purpose well. The fastest rate of exposure is one picture every 2 sec; the slowest, one picture every 14 minutes.

One intervalometer can operate more than one camera. The LK cord from the intervalometer can be connected to the command unit for simultaneous operation of up to four EL/M cameras. The timer in the intervalometer is powered by the camera batteries, and can consequently be used



The multiple connector (**5**) is used when both the automatic diaphragm (**1**) and release cord (**6**) or other triggering device need to be connected to the outlet on the 500EL/M battery compartment, e.g. the cable reel (**2**), intervalometer (**3**) or radio release (**4**). The cable reel holds 98 feet (30 m) of three-core cable and has a transistorized amplifier in the connector (A). The camera can be released by pressing the button (C) or, if the rotary switch (B) is set, by photoelectric means. The cable is wound into the holder by the crank (D).
When connecting cords become longer than 100 ft, the amplifier (**7**) must be used; the amplifier is connected to the camera and the cords to the amplifier. When the multiple connector is also used (**8**), e.g. with the automatic diaphragm (A), the amplifier (B) goes between the multiple connector (C) and extension cord—not between the camera and multiple connector.

outdoors as well as inside. The intervalometer consumes only about 300 mA and need not be considered in estimating battery life.

Multiple camera operation

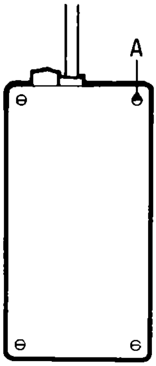
Multiple camera operation, taking simultaneous pictures with more than one camera, has many interesting possibilities and important applications in many fields of photography. It usually involves recording unique events, when the photographer has only one opportunity to capture the scene on film and no time to change film, lenses, or camera angles. It could be the finish of a horse race or 100 yard dash, the take-off on a ski jump or almost any other sports action. To record the event as a colour transparency and a black-and-white print, load one camera with colour slide film and the other with black-and-white. For an overall view and a close-up at the same moment, set up one camera with a normal or wide-angle lens and another with a telephoto lens. Another application of multiple cameras is to record the action from two or more different angles. For example, in a boxing match, actions can be recorded simultaneously from up to four different angles.

Pairs of stereo pictures, even action shots, can be made easily with two motor-driven cameras. Hasselblad cameras were used extensively in multiple set-ups in the space programme, mainly for the purpose of recording simultaneous images on different film emulsions. This application, known as multi-spectral photography, is used mainly for investigating water pollution problems or diseases in fields and forests. The images on different films, including infra-red, and taken through different colour filters, can show the scientist the source of the problem, which may not be possible from one image. Panoramic images which stretch across all screens in a multimedia show are taken with a set of cameras lined up so the areas match together accurately.

Command unit

It is not difficult to release two or more cameras simultaneously. The command unit is used for this purpose. It consists of a release button connected to four outlets so up to four cameras fire when the release is depressed. The connection between camera and command unit is made with the LK connecting cords. If less than four cameras are used, make certain that one camera is connected to the outlet with the red dot. This is necessary because the command unit gets the power from the camera battery through this outlet. The multiple cameras can also be released from the intervalometer, the radio or any other triggering device.

Multiple camera photography can be successful only if all cameras fire. Should one fail, the entire undertaking may be a failure. Each socket on the command unit has a warning light. If a light stays on after the exposure has been made, the camera connected to that socket did not go off—perhaps the



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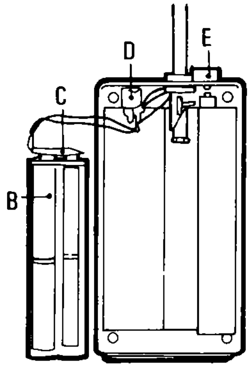

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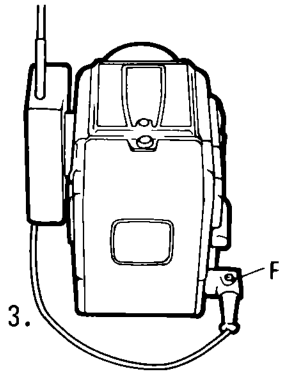
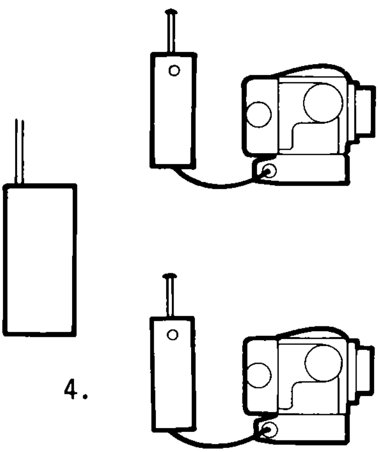


Radio release

The radio transmitter (**1**, **2**) is powered by eight 1.5 V penlight batteries (B) connected through the socket (C). To replace the batteries, unscrew the four screws (A) on the rear panel of the transmitter and lift off the front cover. The camera is released by pressing the release button (E) or with up to 100 ft of cable connected to D. A red light is displayed during transmission.

The radio receiver is powered by the camera batteries and is connected to the side socket (**3**F).



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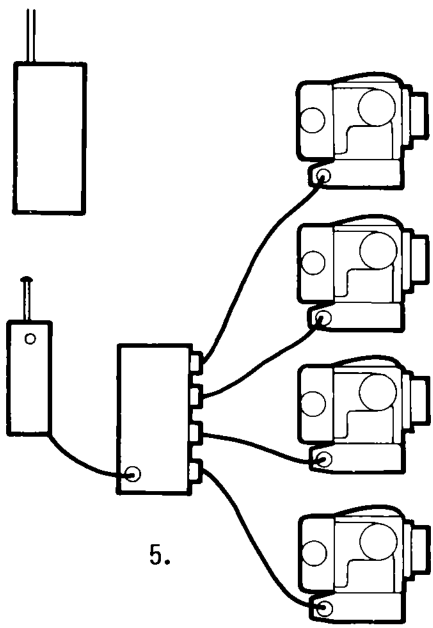
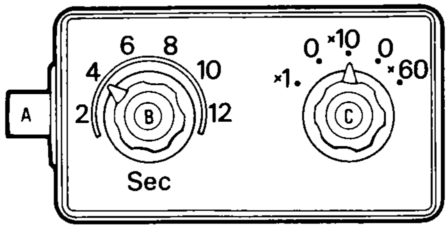
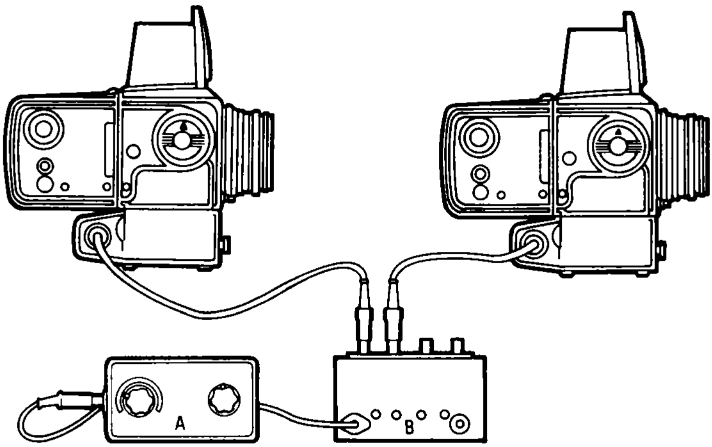


5.

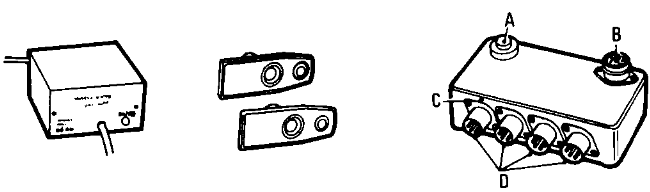
4 Any number of cameras can be fired simultaneously from a single transmitter providing each is equipped with a receiver. If only one receiver is available (**5**), up to four cameras can be triggered simultaneously through the command unit.



The intervalometer is connected to the camera through socket A. It is turned on by setting the right dial (C) to × 1, × 10 or × 60. At × 1 the exposure intervals range from 2 sec to 14 sec depending on the position of the left dial (B). At × 10, the seconds on the left dial are multiplied 10 ×, so that 6 sec becomes 60 sec. At × 60, the seconds are multiplied 60 times so that the seconds become minutes.



By combining the intervalometer (A) and the command unit (B), up to four cameras can be fired simultaneously at the set intervals. The cameras could also be equipped with automatic aperture control lenses.



The power supply unit (*left*) makes the 500EL/M independent of the battery power source when an AC source is available. A special motor housing panel replaces the normal one when the unit is used. The unit is attached to the socket on the panel via a 3 ft long cord which can be extended by the LK cords.

Up to four cameras, connected to the outlets D, can bė released simultaneously by the command unit (*right*). If less than four cameras are used, one must be connected to the outlet with the red dot (C) through which the unit receives its power. The cameras are released with the release button (A) or by remote means through socket B. On newer models, there are four warning lights on the top of the unit which light up if the corresponding connected camera was not triggered. Simultaneous release of more than four cameras is made possible by interconnecting two or more command units.

camera is out of film. Multiple camera operation with Hasselblad is not limited to four cameras. Two or more command units can be coupled together. Just make sure the red dotted plug is used in every one of the command units.

7

Operating the Superwide

ON THE SUPERWIDE C, the use of film and film magazines, the operation of the 38 mm Biogon lens and the releasing are identical to the 500C/M, except that it has no auxiliary shutter or mirror. There is no prerelease sequence, and you do not have to keep the button pressed for longer exposures (except on B). Where the camera operation differs is in the method of holding and viewing.

Holding the camera

Photographers usually hold the Superwide in one of two ways. The most popular is with the left hand placed underneath the camera and lens, the right hand placed flat against the right side of the camera with the index finger on the release.

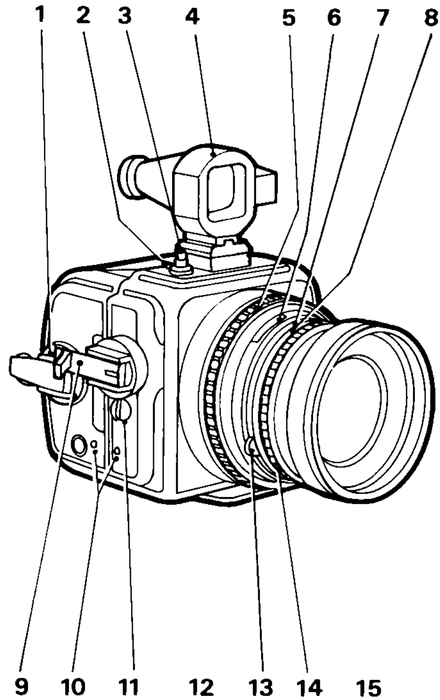
In the other method, the camera is held between the two hands, the left hand on the left side of the camera, the right one again on the right side with index finger on the release. In both methods, the elbows can easily be pressed into the body and then provide exceptional steadiness. For best camera steadiness, press the Superwide hard against your cheek, with your eye centred behind the viewfinder eyepiece.

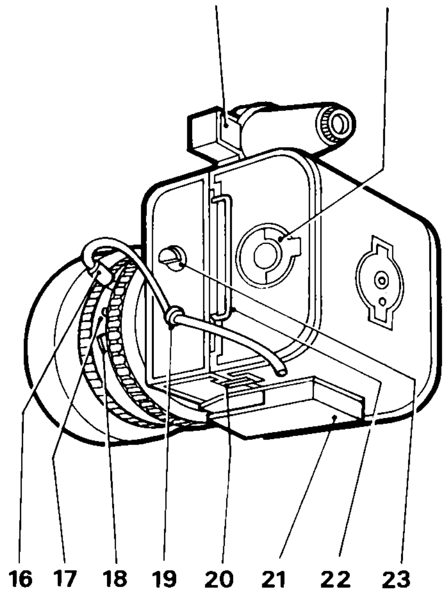
The Superwide viewfinder

The optical viewfinder of the Superwide is a separate removable component which slides from the rear into the shoe mount on top of the camera. Slide it forward until it rests against the pin. On the SWC/M the finder can be used with the Polaroid magazine. On the SWC, it must be removed to fit the Polaroid film magazine.

The viewfinder has the same angle of view as the 38 mm Biogon lens, but being somewhat behind the lens, it shows a slightly larger area than is

The Superwide C





1 Magazine transport key.
2 Time exposure lock.
3 Release button, with cable release socket.
4 Wide-angle finder.
5 Focusing mount.
6 Depth of field indicator.
7 Aperture scale.
8 Shutter speed scale.
9 Winding crank.
10 Film transport signals.
11 Fitting for carrying strap.
12 Prism for reflecting spirit level.
13 Finger hold for aperture and exposure value settings.
14 Shutter speed setting ring.
15 Magazine locking key.
16 Flash socket.
17 Synchronizing lever.
18 Synchronizing lock.
19 Flash lead anchored in cable hook.
20 Hooks to engage the magazine.
21 Baseplate with tripod socket.
22 Magazine slide.
23 Strap holder.

covered on the film. To be exact, the area you see in the finder is 75 mm (3 in) wider on each side and 150 mm (6 in) higher at the top than the area covered on the film. These measurements apply at all distances. In other words, the lens covers 150 mm less on top and 75 mm less on both sides, regardless of whether the picture is taken at 60 cm (2 ft), 3 m (10 ft) or 30 m (100 ft).

How does the enlarged viewing area affect the accuracy in framing? Considering the wide angle of the lens, and therefore the very large area coverage, a 150 mm difference on top or 75 mm difference on each side is hardly recognizable and never a problem at longer distances—certainly not at 3 m (10 ft) or more. At closer distances, 60 cm (2 ft), for instance, where the camera covers a 70 cm (32 in) wide square, or at 30 cm (1 ft) where the area coverage is only 35 cm (16 in), the difference in coverage is recognizable and should be allowed for. Align the camera so that you see 75 mm more on each side in the finder and most important, so that you see 150 mm more on top. There is no allowance necessary at the bottom of the field as the viewfinder and lens fields coincide at all distances.

When looking through the viewfinder, it is disturbing to find that the lens is in the field of view and cuts off a good portion of the view at the bottom. While this may be objectionable, it really does not interfere with precise camera alignment because the bottom edge of the field can be seen on both sides of the lens. You can see, therefore, exactly how much is taken in at the bottom of the picture. When a sun shade (lens hood) is attached to the lens, the cut off is even greater, but even with the professional lens shade on the Biogon, you can see the bottom edges on both sides of the shade.

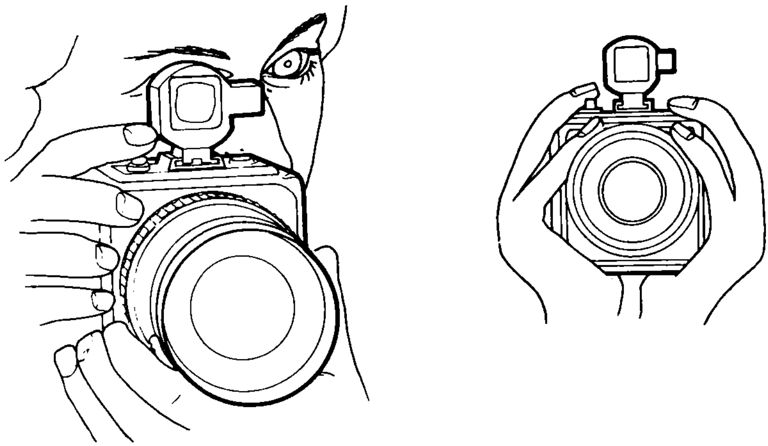
The barrel distortion seen in the finder may also be disturbing at first. It is something you can get easily accustomed to and it certainly does not interfere with accuracy in framing.

To frame the desired area horizontally, make certain you see the area across the center of the viewfinder field, at the widest point of the curves. Align the top at the highest point, if necessary allowing for the 150 mm parallax difference. The curvature appears only in the finder; on the film, straight lines are straight, even close to the edges as the Biogon is known for its superb distortion correction.

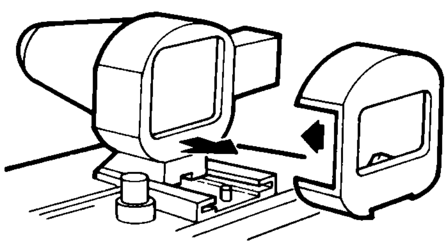
Masks are available to show the area covered when magazine 16 or 16S is used on the Superwide. The black masks slide over the front of the Superwide finder.

Levelling the camera

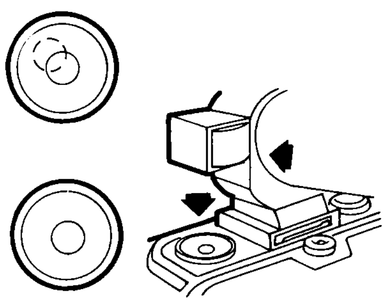
When vertical lines, of a building or product for instance, must be recorded parallel to each other so the subject appears to be standing straight up, the camera must be level. Any tilting of the camera records the verticals as slanted lines. With an extremely wide-angle lens like the Biogon, the slightest tilt is recognizable as the slanting of the lines is enhanced.



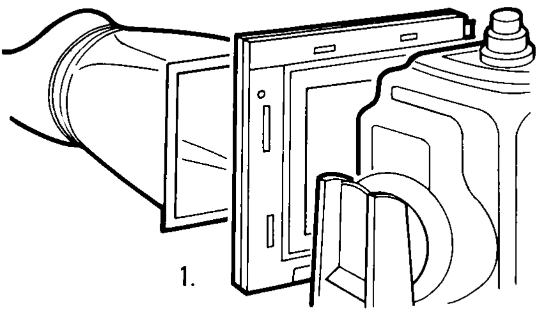
Holding the Superwide
There are two convenient methods of holding the Superwide. You can rest the camera in the left hand in a similar way as for the other models and release it with the index finger of the right hand. As the camera is small, you can place both hands around the camera body with the middle finger on the release.



The Superwide viewfinder (*left*) is a separate component. It slides from the rear into the shoe mount on top of the camera. Masks to show the area covered by magazine 16 and 16S can be attached to the front of the finder.



The spirit-level (*right*) on top of the camera is reflected in the viewfinder prism so it can be seen from the normal viewing position behind the camera.



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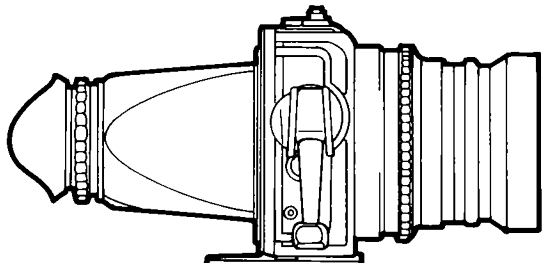

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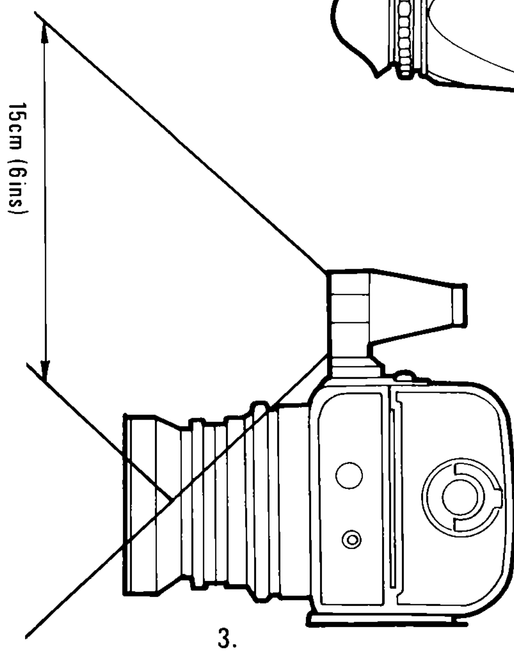
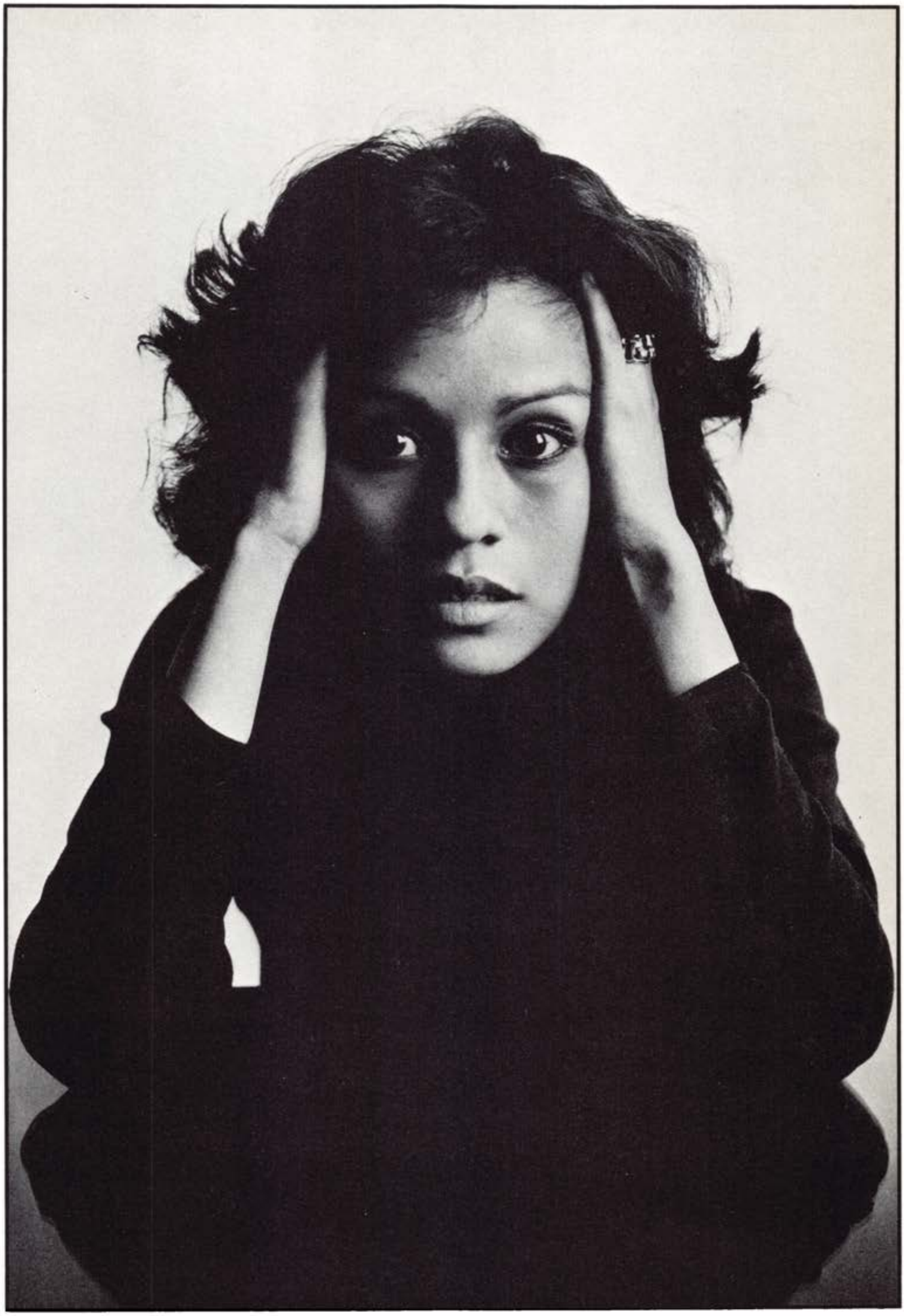


3.

Accurate framing and ground-glass focusing is possible with the focusing screen adapter (**1**) attached to the rear of the Superwide after the film magazine has been removed.

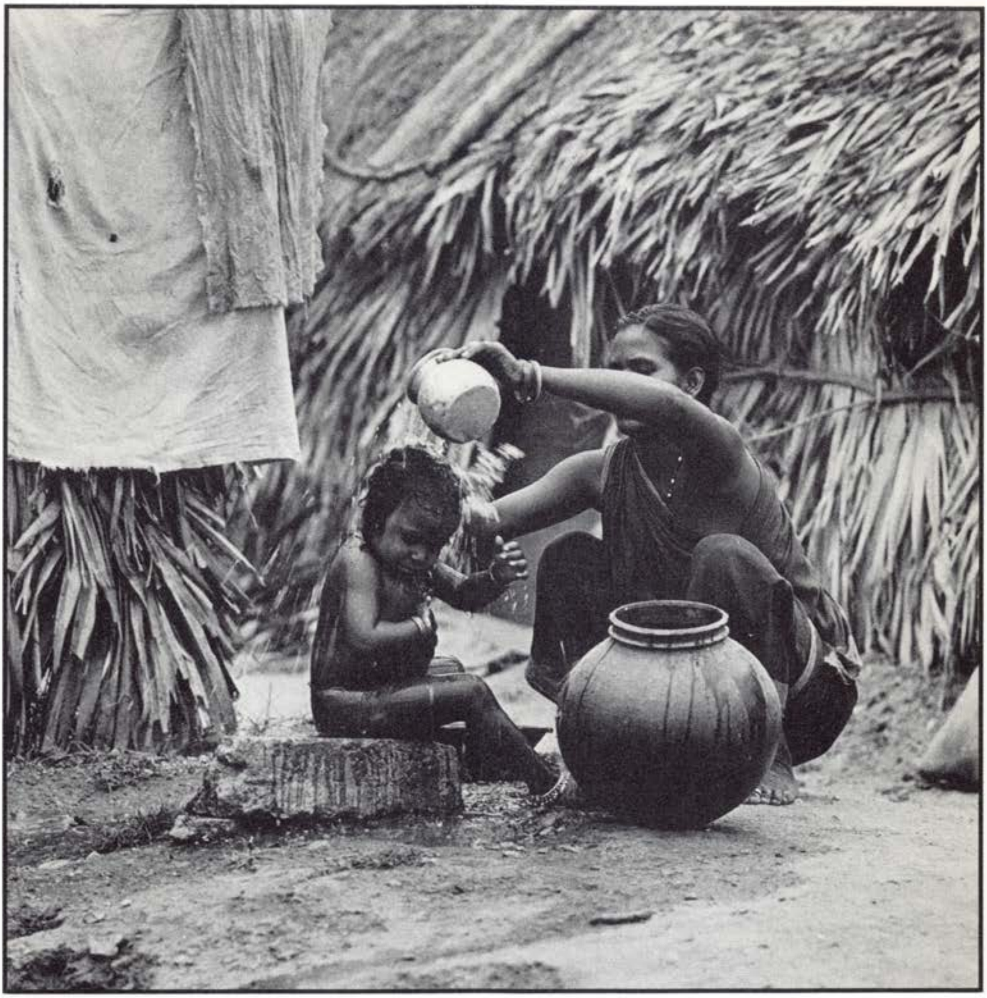
The ground-glass image can be magnified and shielded from extraneous light by any of the viewfinders (**2**) made for the single-lens reflex models. The finders slide into the ground-glass screen adapter from the top.

The Superwide viewfinder (**3**) sees 15 cm more on top and 7.5 cm more on each side than the actual area covered on the film. This is the case at all distances. No compensation is necessary at longer distances but allowance should be made in close-ups.



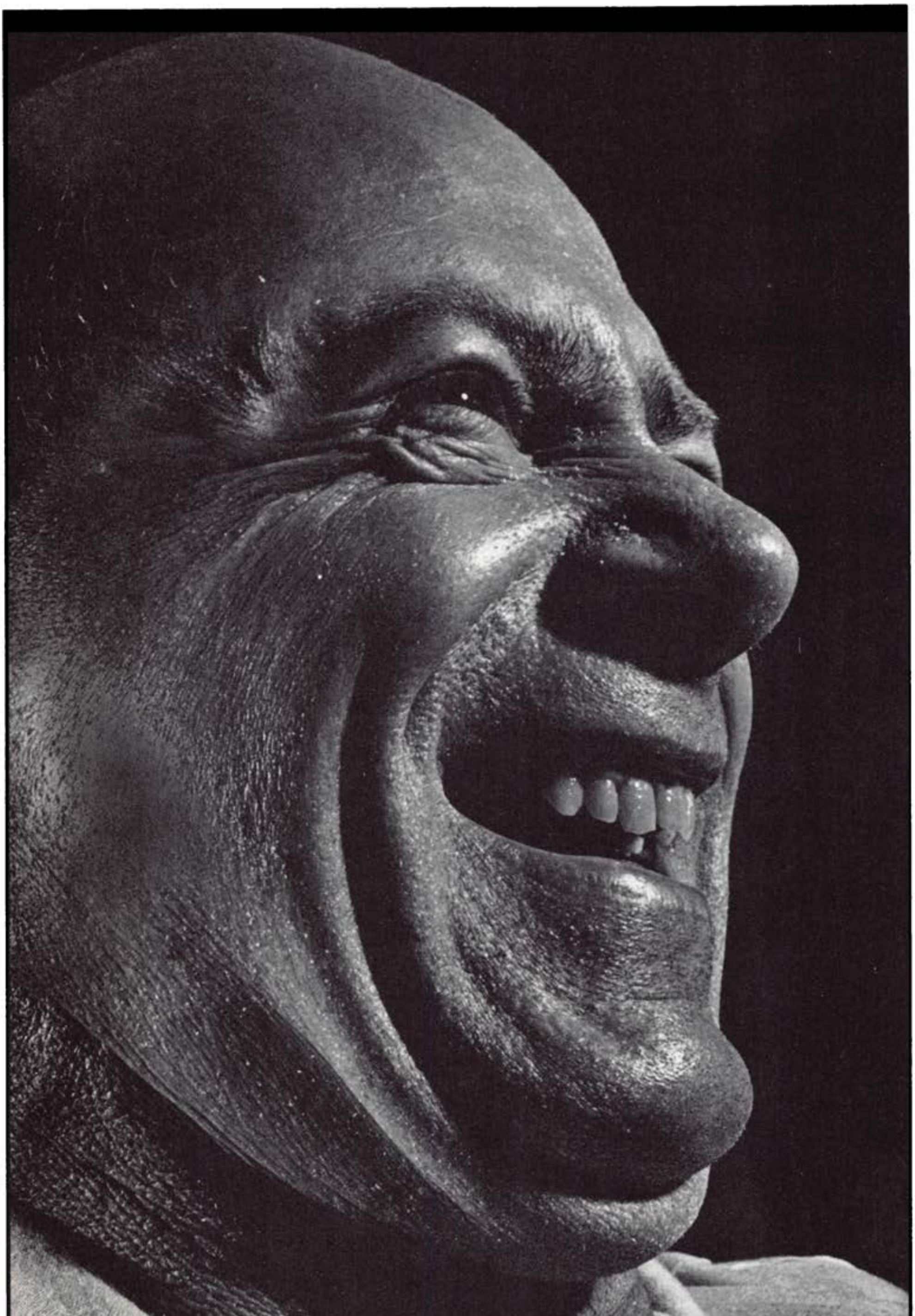
◁*A simple, direct portrait in which the strengths of a pyramid composition are reinforced by a harsh distribution of light and shade. Highlights are mainly concentrated in the face and hands; the remaining shadow areas are allowed to lose all detail and the figure as a whole comes boldly forward from the undefined white background.* Judy Olausen.

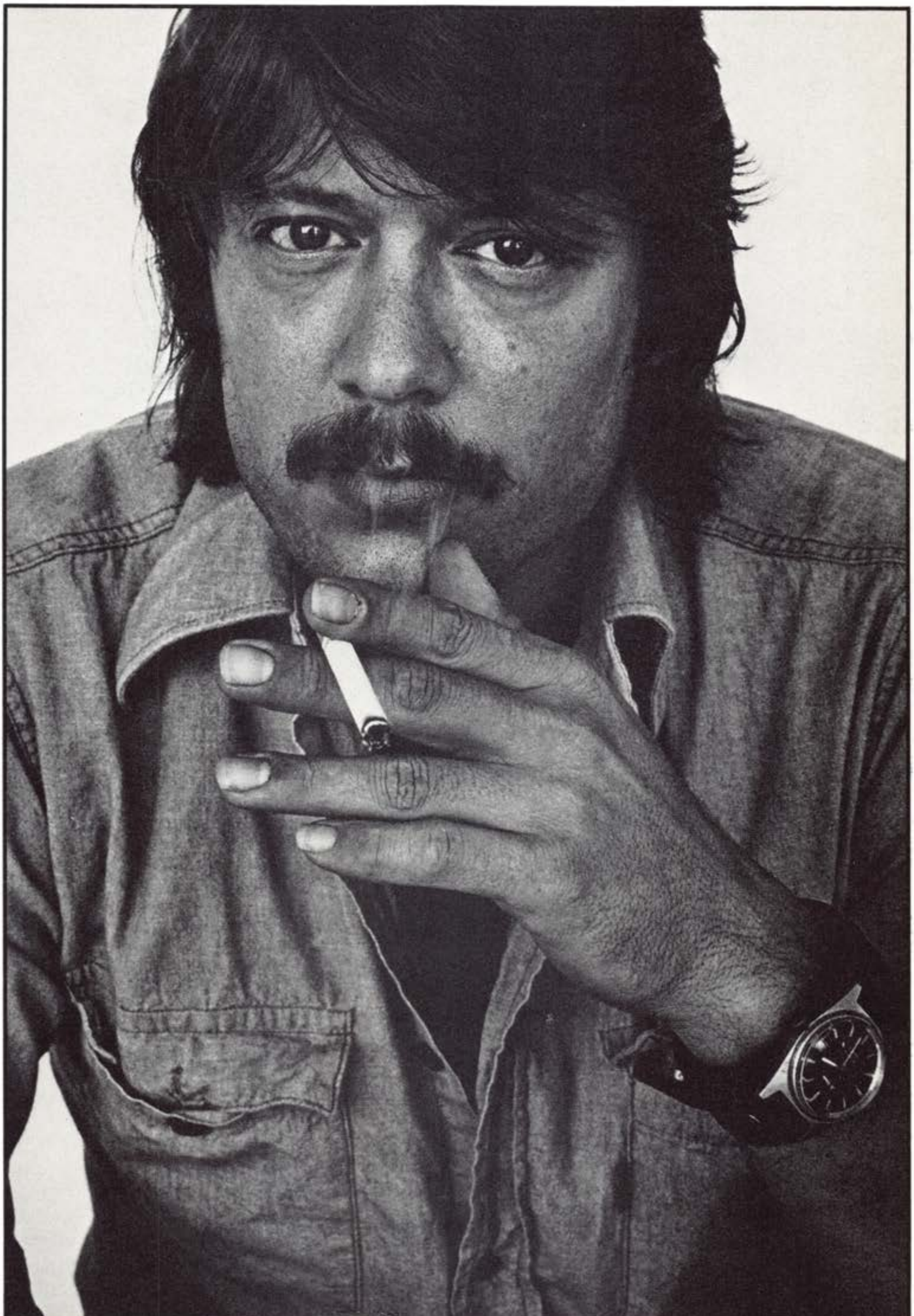
△*The spacious format of the 6 × 6 rollfilm format allows great contrasts in size between subject and surroundings without loss of fine detail in either, however large or small the subsequent print. The generous exposure toleration of rollfilm ensures that all tones are recorded—even with a wide subject contrast range.* Neelkant Sharma.

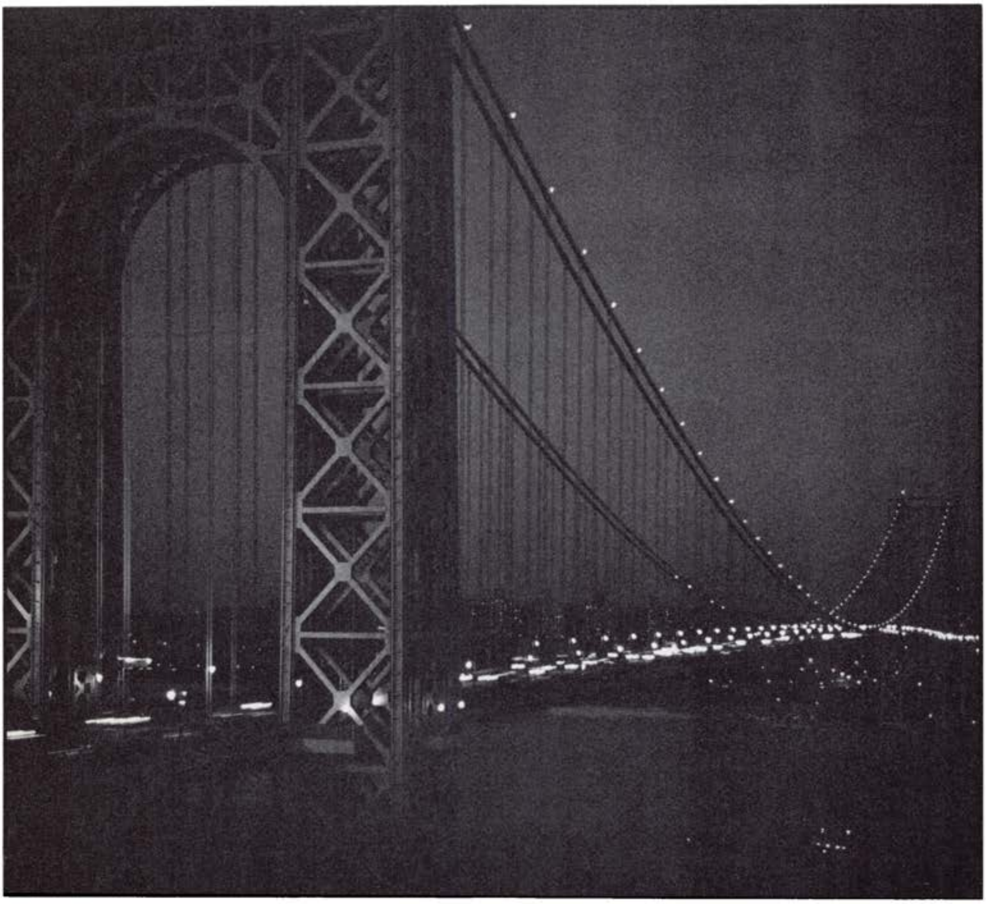


△*The Hasselblad in a documentary role (India). Fast film allows sufficiently short exposures for even the longer focal length lenses to be used hand held, yet the relatively coarse grain structure of such films is not evident in enlargements from the 6 × 6 cm format.* Neelkant Sharma.

▷*The main difficulty with photographing a person laughing is that, even if anticipated, the head movement is liable to result in blur from movement or lack of focus. Flash (two off-camera units were used here) solves both problems and even allows an extra close viewpoint. In this case the picture area was filled using a 50 mm Distagon.* Vern Arendt.

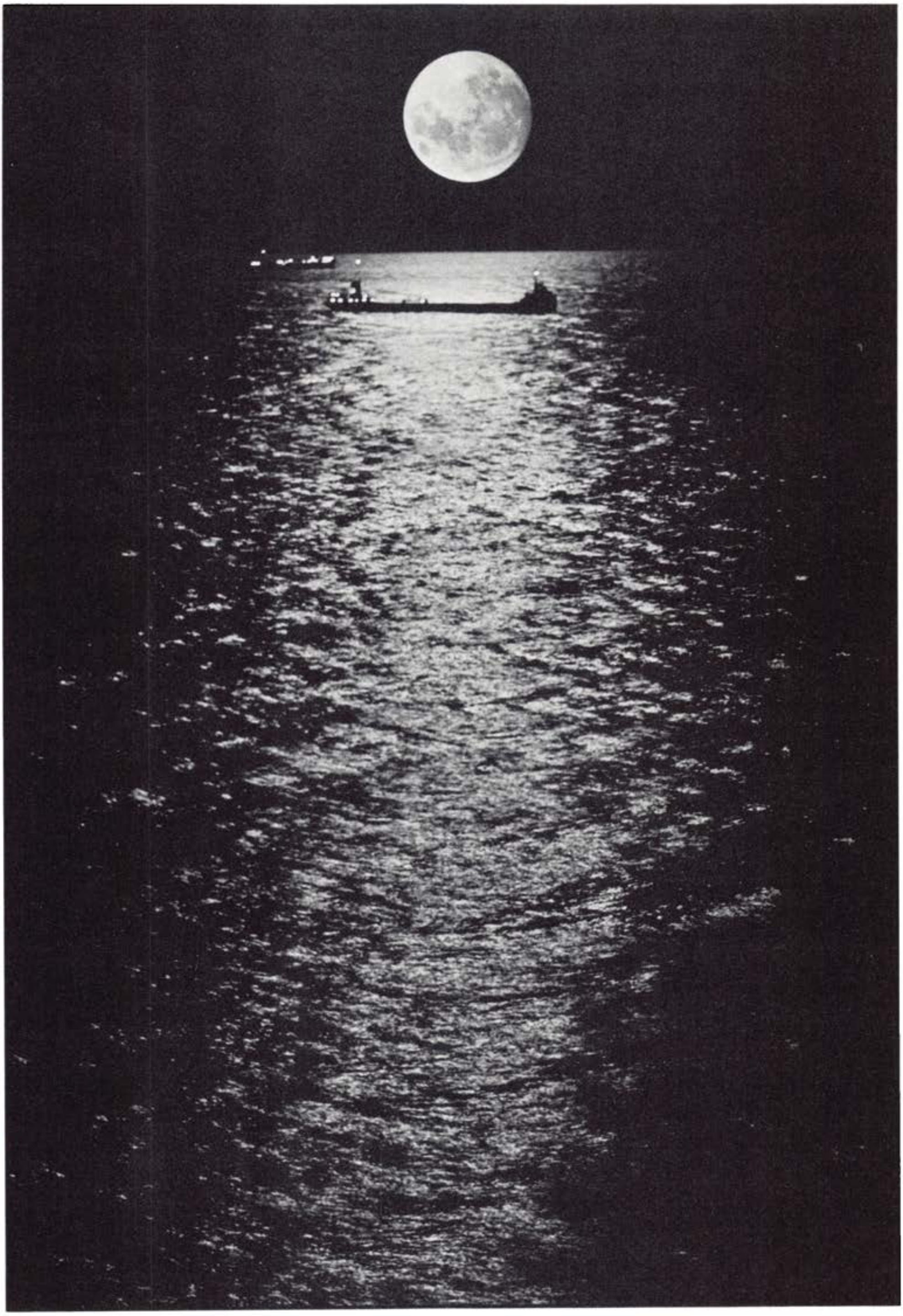




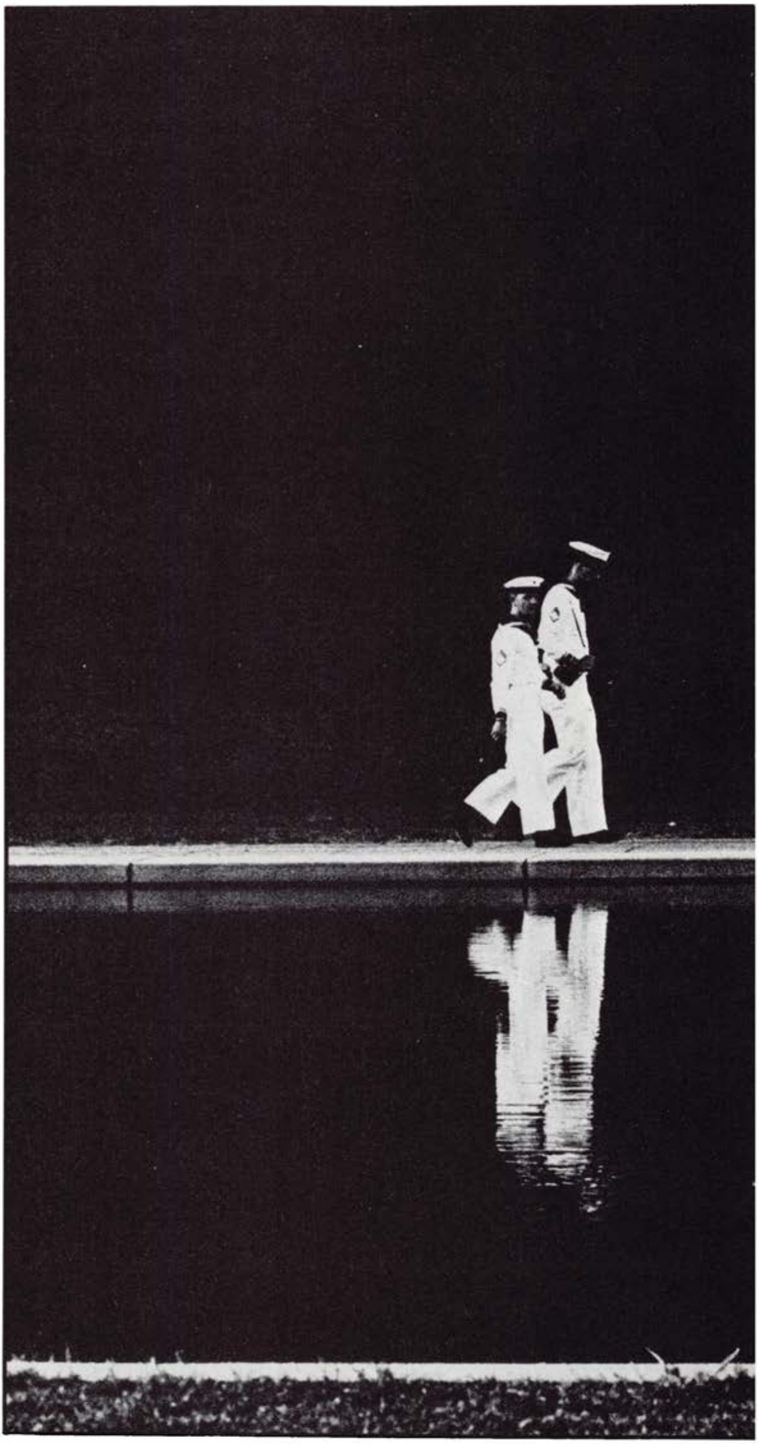


◁*Personality is expressed to some extent through natural gestures spontaneously captured. A head-on viewpoint with the eyes looking directly into the camera commands our attention. Focus must be on the eyes, regardless of other details in the picture. In this picture the natural lighting allowed only a shallow depth of field.* Judy Olausen.

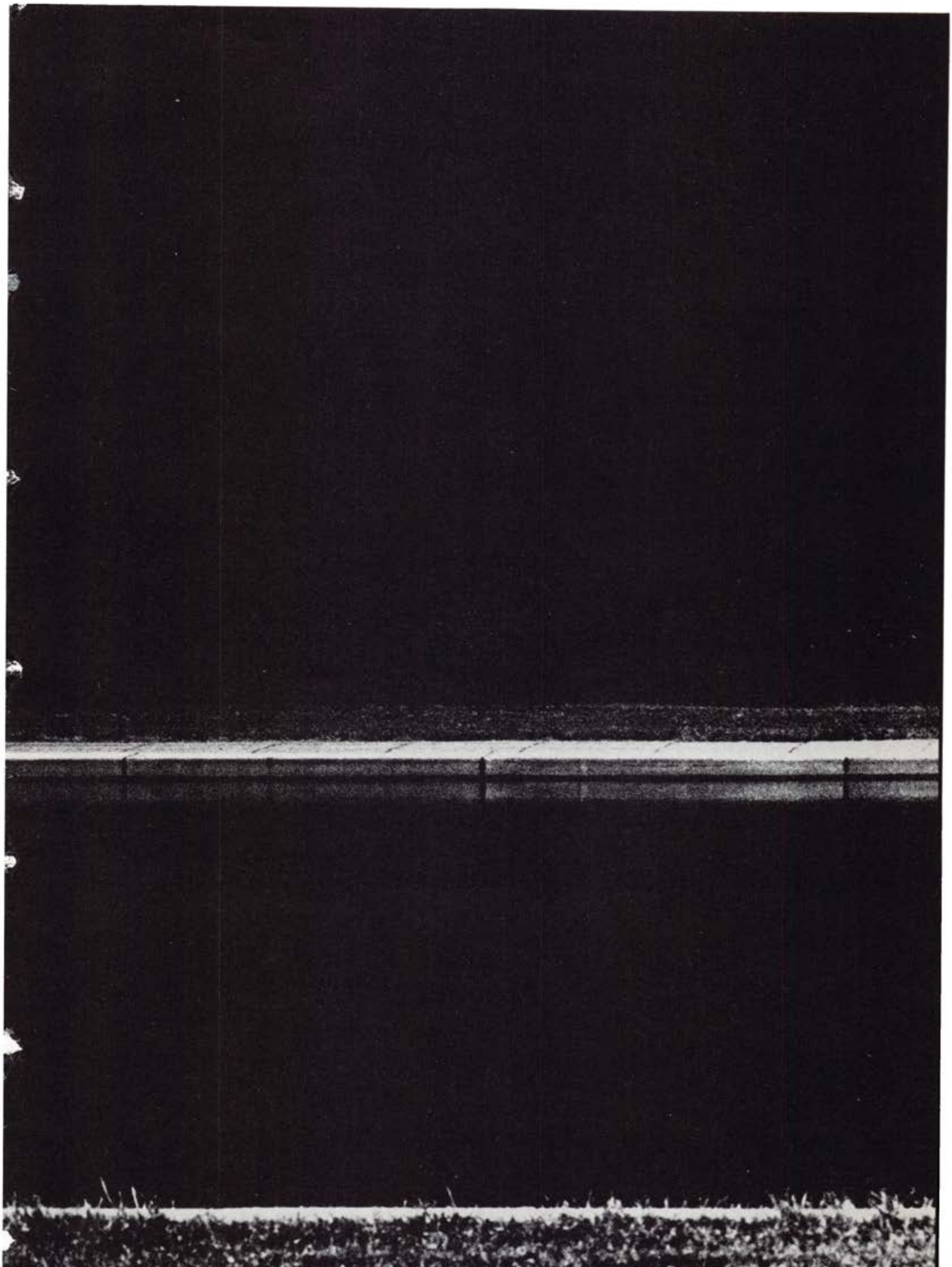
△*Low light photography. Images of illuminated structures are rendered in the most effective way at dusk when some light remains in the sky to outline the structure without drowning the effect of the lights themselves. Exposures, based on a general reading, should be bracketed to ensure the optimum effect.* Ernst Wildi.



▷ *Black-and-white photography offers scope to manipulate the contrast ratio of different picture areas, reducing the composition to simple force lines. In this case, the position of the figures left of centre with a balance of space in front gives an area for the figures to 'walk into'. The strong horizontal lines suggest an effect of horizontal movement.* James B. Johnson.



◁ *The moon and reflection taken in a single exposure with a 500 mm Tele Tessar lens. This type of picture is often achieved only by using a combination of separate negatives taken under the most favourable conditions for the different components. For such pictures and indeed, for nearly all photography, this long lens must be rigidly supported using a very solid tripod, or two lighter ones, one supporting the camera body and the other the lens barrel.* Vern Arendt.



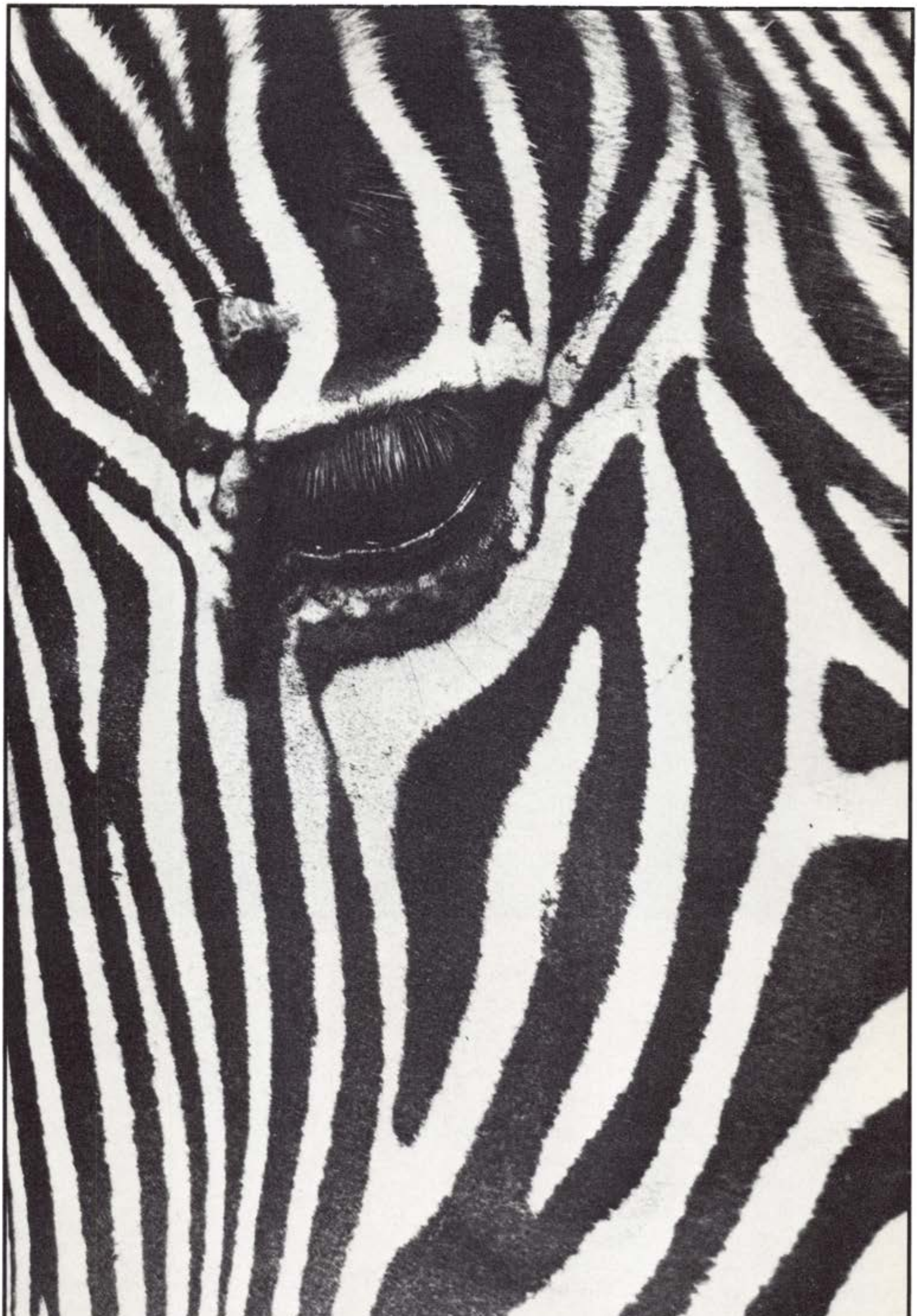
△*The sea pounding the coast of Holland seen in evening light against heavy cloud. Contrast has been exaggerated in printing to emphasize the spray formation. Such pictures call for very quick reactions and a high shutter speed to arrest the water formation at the critical point.* Wim Reimens.

▷*Flames and smoke from a tanker. This picture was taken through a red filter which whitens the red flames and increases the tonal contrast between them and the black smoke when photographed on monochrome film.* Vern Arendt.


DIAMOND REO
FLAMMABLE

A small change in camera position between two almost identical views makes one much more pleasing to the eye. In the picture above the closer viewpoint and slightly different angle fits the wood structure to the picture frame, reduces the sky and foreground areas, and excludes background objects above the roof ridge. Paul Petzold.

▷ *A close viewpoint isolates the markings of a zebra's coat as an abstract pattern. Black-and-white photography particularly lends itself to such techniques the white areas here have been allowed to lose detail and so augment the effect.* Ed Buziak.



△*Winter afternoon. Intentional underexposure ensures full detail in the sky and reduces the main picture constituents to silhouetted shapes. The wet road catches sufficient light from the sky to balance the foreground (which has no other detail) with the remainder of the picture. The necessarily precise adjustment of camera position is easily controlled on the ground-glass screen of the Hasselblad.* Paul Petzold.

Δ *A shallow coastal inlet with a wide expanse of water. The scenery formed the basis of the picture design at the expense of the sky. Slight underexposure reduces the foreground to silhouette but faithfully records the atmospheric haze in the far distance and on the horizon.* Wim Reimens.

Δ *A Superwide C camera records the sweeping curve of a glasshouse and its reflection in a fountain at Syon Park in England. The extreme perspective effect of working from a relatively close viewpoint becomes fixed in the mind's eye after using the Superwise camera for a period of time.* Ed Buziak.

The Superwide viewfinder has a prism on its left side. When the finder is mounted on the camera, the prism is positioned right above the fixed spirit level. It reflects the image of the spirit level to the rear of the camera, where it can be seen while viewing through the finder. The same eye that views through the finder is used to check the position of the bubble in the spirit level. With the camera pressed against your cheek, push it just a little to the right and your eye will look right into the spirit level. You can switch the view almost constantly from the finder to the spirit level and back with just this tiny movement of the camera.

Focusing

At longer distances the Biogon lens is focused by estimating the camera-to-subject distance. This is no problem as the short 38 mm focal length provides considerable depth of field. At the maximum aperture of *f*4.5, depth of field extends from 3 m (10 ft) to infinity, or from 1.5 m to 3 m (5 ft to 10 ft)—obviously within a range anyone can estimate. This is not so at closer distances. At 60 cm (2 ft) with the lens wide open, total depth of field is only 10 cm (4 in); at 30 cm it is a fraction of an inch, less than 1 cm, and the lens must be closed down completely to *f*22 to get a total depth of field of 50 mm (2 in). Then estimating is not good enough and the distance from the film plane mark engraved on the film magazines to the subject should be measured.

You can also focus accurately by removing the film magazine and attaching in its place the focusing screen adapter. Its ground-glass screen is in the exact plane of the film just like the ground glass on a view camera. The screen incorporates a Fresnel lens and therefore yields a bright image even out in the corners. The ground-glass adapter is great, not only for focusing, but for accurate framing, or evaluation of the image. It is most valuable when working from a tripod. To see an image on the ground glass, set the shutter at B, and keep it open by placing the release lock to T. Open the lens wide for most accurate focusing.

The image on the ground glass can be viewed through any one of the Hasselblad viewfinders, the standard hood, the magnifying hood, the 45° or 90° finders or the prism finder with exposure meter. The finders slide into the grooves on the adapter and are held in place by a pin on the upper left.

To remove the finder, push the pin to the left, and slide out the finder. All finders provide a magnified view of the entire ground-glass image and shield the ground glass from all extraneous light.

The focusing screen adapter can be attached to all Hasselblad cameras. Since all the other models already have a ground-glass screen, it serves no practical purpose, except if one wants to check whether the focusing corresponds to that obtained on the regular ground glass.

8

Operating the 2000FC

Film magazines

The film magazines are attached to the 2000FC camera and used in exactly the same way as on the other models. There is only one difference: the magazine 80 for Polaroid film cannot be used on the 2000FC because the protruding glass plate is too close to the focal-plane shutter. All other Hasselblad film magazines are usable.

Viewfinders and ground-glass screens

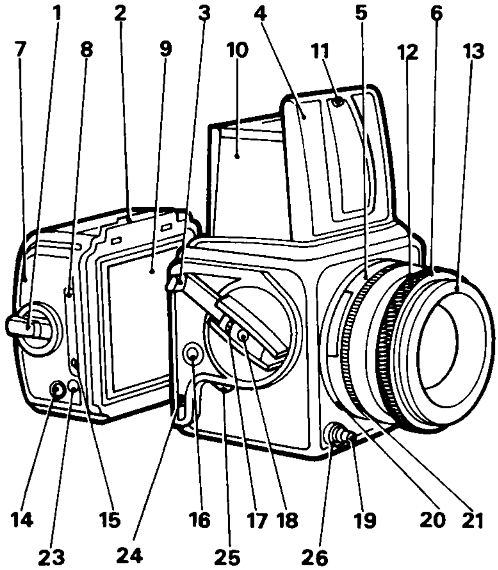
All viewfinders and ground-glass screens are usable and are attached and removed as on the other SLR models.

Lenses

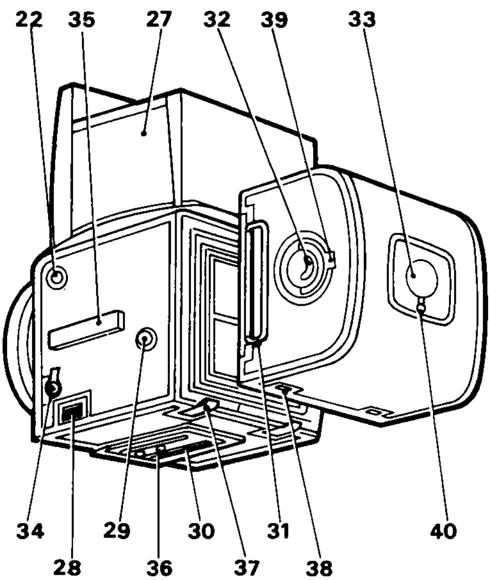
The 2000FC has the same bayonet lens mount as other models and exactly the same distance between the lens mount and film plane. The camera can therefore take all lenses with Compur shutters as well as the special non-shutter lenses made for the 2000FC. All the lenses are attached and removed from the camera following the procedure for the 500C/M and 500EL/M. Always hold the F lenses on the non-movable ring when attaching or removing them from the camera. Never press on the shutter and diaphragm cross coupling ring when removing a lens. It could possibly damage the mechanism.

Accessories that attach to the lens mount, like the bellows extension, lens mount adapter and microscope adapter, are also usable. The 16 mm, 32 mm and 55 mm extension tubes can also be used, but not the 10 and 21 mm lengths. The rim of these latter two tubes hits against the camera's shutter speed ring before the tube can catch the camera's bayonet mount.

Hasselblad 2000FC



1 Magazine winding crank.
2 Magazine latch.
3 Film transport crank.
4 Focusing hood.
5 Aperture scale.
6 Focusing ring.
7 Film magazine.
8 Magazine designation (i.e. 12, 16, 24, 70).
9 Magazine slide.
10 Folding focusing hood.
11 Focusing hood and magnifier latch.
12 Distance scale.
13 Bayonet accessory mount.
14 Film counter.
15 Film plane mark.
16 Carrying strap lug.
17 Mirror program settings.
18 Mirror program disc.
19 Cable release socket.
20 Shutter speed scale.
21 Fixed grip ring.
22 Flash sync terminal.
23 Film advance indicator.
24 Shutter cocking indicator.
25 Pre-release latch.
26 Shutter release·
27 Standard hood.
28 Battery compartment.
29 Carrying strap lug.
30 Tripod plate.
31 Magazine slide.
32 Film consumption indicator.
33 Film type indicator.
34 Shutter speed ring lock.
35 Accessory rail.
36 Tripod socket.
37 Magazine support hooks.
38 Magazine support hook seating.
39 Film holder locking key.
40 Film speed indicator.



Film winding crank and exposure meter knob

The winding crank on the 2000FC is not removable. You can use it as a crank (with the crank lifted up) or as a winding knob (with the crank folded down). Having a permanent winding crank does not prevent the use of the exposure meter knob and making it part of the camera. Attach it to the square sunshade with the meter attachment.

Camera operation

The shutter speeds and the focal-plane shutter operation are controlled electronically with the power from a type PX28 6V battery stored in a battery compartment on the left side (seen from the rear) of the camera. The 2000FC camera does not operate without the battery. If you depress the release or the prerelease accidentally without a battery, or with a battery of insufficient capacity, the mirror rises and the lens diaphragm and a C-lens shutter close. The focal-plane shutter, however, does not operate. Once the camera is in this position, the lens cannot be removed. To reset the camera to its original state, depress the chrome program disc on the winding crank while turning the crank, as for a double exposure.

To insert or change a battery, pull out the battery compartment using two fingernails. Insert the battery with the (–) and (+) ends as engraved on the compartment. Push the compartment completely into the camera body. Remove and insert the battery compartment only when the camera is in the 'ready' state with the shutter cocked and the mirror down. Always turn the winding crank with the chrome disc depressed before inserting a battery.

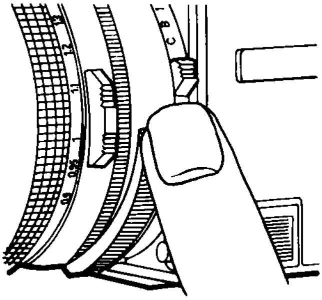
The electronic circuit of the 2000FC includes various patented features. One is a capacitor coupling between the battery and the magnets that operate the shutter curtain, so very little power is drawn from the battery the moment the release is depressed. As a result, a large number of exposures (approximately 20000) can be made before it is necessary to change the battery.

Shutter operation

The focal-plane shutter consists of two curtains made from titanium, only 0·014 mm thick and completely flexible. Their strength and ease of reeling is further increased by a patented corrugated profile.

The curtains move horizontally across the image area. The two curtains are preset to form a slit of suitable width to produce 1/2000 sec shutter speed. At any other shutter speed, the first curtain moves as the release is depressed and the second curtain is delayed so that a wider slit is formed producing the longer shutter speed. The delay of the shutter is timed electronically and is consequently very accurate and practically unaffected by temperatures.

The shutter speeds are set on the shutter speed ring around the lens



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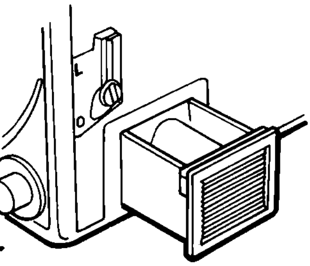

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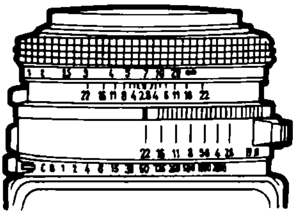

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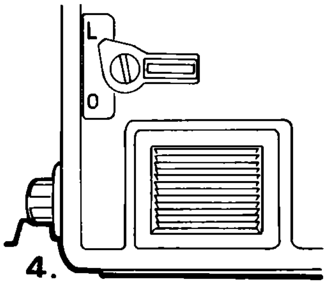

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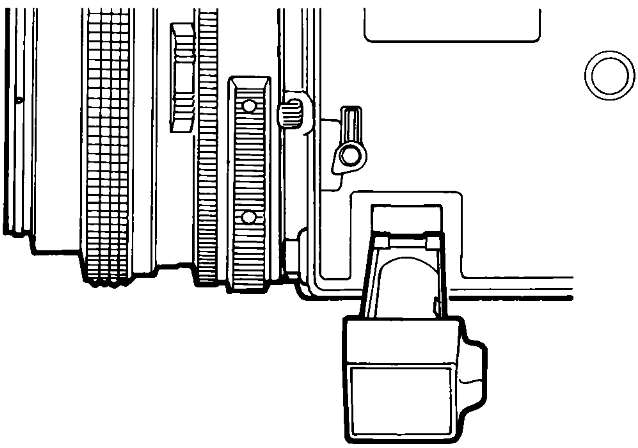


5.

1 The shutter speed ring can be conveniently operated with the thumb of the left hand while the rest of the lens controls are operated with the right hand.
2 The battery compartment can be pulled out using two fingernails. Insert battery with the '+' end toward the camera. Remove and insert the battery compartment only when the camera is in the 'ready' state with the shutter cocked and the mirror down.
3 The shutter speed ring can be set not only at the engraved shutter speeds but also between the engraved shutter speeds. The 2000FC therefore has 23 electronically controlled shutter speeds. Set between 4 and 8, for instance, the shutter speed is $\frac{1}{6}$ sec.
4 The shutter speed ring is locked in the L position by the locking lever on the side of the camera. It is especially recommended to lock it when using the C setting of Compur lenses. It is unlocked by flipping the lever up to point to O.
5 The shutter speed multiplier is used in the 2000FC camera in place of the battery container. The battery is inserted into the multiplier with the '+' end towards the camera. With the multiplier in the camera, shutter speeds set on shutter speed ring are increased by a factor of 60 to give speeds longer than 1 minute.

opening. Turn the ring until the required figure is opposite the red index on top of the camera. As on the other Hasselblad models, all lens settings, shutter speed, aperture, distance and depth of field, are visible from the top. The shutter speeds can be set and changed easily by holding the camera, as usual, in the left hand and turning the ring with the thumb of the left hand. This leaves the right hand free to set the aperture or distance at the same time.

The shutter speed can be set either at the engraved speeds or in between any of the engraved figures from 1 sec to 1/2000 sec resulting in shutter speeds halfway between the two engraved figures. For example, between 1/4 and 1/8 sec, the shutter speed is 1/6 sec; between 1/500 and 1/1000, it is 1/750 sec. The 2000FC camera therefore offers a choice of 23 shutter speeds.

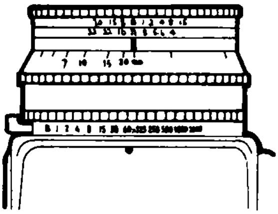
The shutter speed ring also clicks in position between C and B and between B and 1 sec. These two in-between settings, however, should not be used. If set accidentally between C and B, the camera works as it does on either C or B. Set accidentally between B and 1 sec, the mirror flips up and the focal-plane shutter opens but nothing else happens. To reset camera to normal position, turn the winding crank with the program disc depressed. Keep in mind, however, that the film frame in the magazine has been exposed, so release once more and advance the film.

As the shutter speeds are timed electronically, it is not necessary to keep the release depressed until the shutter closes, even at the long shutter speeds from 1 sec to 1/4 sec. It is necessary only at B, where the shutter opens when you press the button and closes when you release it. For long exposures, use a cable release with a lock as there is no release lock on the camera. In position C, the shutter also stays open as long as the release is depressed. This setting is used when the Compur shutter in the lens is used. The focal-plane shutter operates exactly as the auxiliary shutter, so keep your finger on the release until the lens shutter closes, otherwise the focal-plane shutter will close before the lens shutter.

Once the shutter speed has been set, you may want to ensure that it is not changed accidentally. Flip down the lever on the side of the camera next to the battery compartment, so that the little arrow points to engraving L (lock). When you use the Compur shutter in the lens, you are especially advised to lock the ring in the C position.

Shutter speed multiplier

When shutter-speeds longer than 1 sec are required, this accessory will multiply the set shutter speeds by 60. In-between speeds can also be obtained by setting the shutter speed ring between the engraved figures. The operation of the camera with the shutter speed multiplier is otherwise the same as without this accessory. The shutter speed multiplier is inserted in the camera in place of the battery container. The battery goes inside the shutter speed multiplier.



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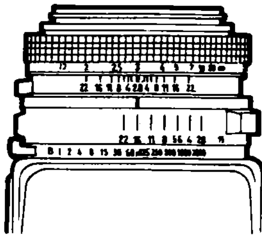

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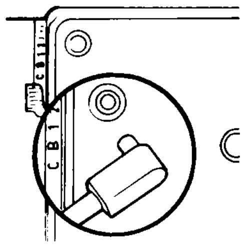
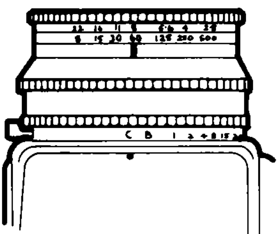


3.

Using Compur shutter lenses on the 2000FC (**1**–**5**)
When the focal-plane shutter is used, set the lens shutter on B and the focal-plane shutter at the desired shutter speed (**1**). Flash can be used at B and at shutter speeds from 1 sec to $\frac{1}{90}$ sec which is marked with a red x on the shutter speed ring (**2**). To prevent accidental shooting at higher speeds, the flash does not fire when the shutter is set above $\frac{1}{90}$ sec.

The sync cord is attached to the PC contact on the side of the camera body (**3**).

To use the Compur shutter, set the focal-plane shutter to C and the lens shutter to the desired shutter speed (**4**). All shutter speeds up to $\frac{1}{500}$ sec can be used with flash. The flash sync cord is attached to the PC contact on the lens (**5**).



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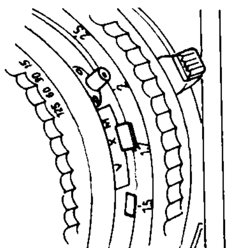

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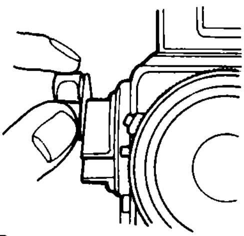
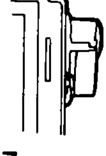


6.

Film winding
The 2000FC winding knob is equipped with a foldable winding crank (**6**, **7**). It is not interchangeable. The meter knob can be attached to the square sunshade using the attachment for meter knob accessory (**8**).



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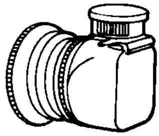

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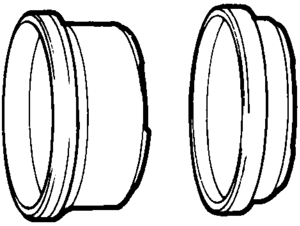


9.

Extension tubes (**9**) are attached to the 2000FC as on the other cameras but only the 16, 32 and 55 mm tubes have a long enough clearance between the bayonet mount and the front ring to clear the shutter speed ring of the camera.

SHUTTER SPEED CHANGES WITH A MULTIPLIER (SECONDS)

Shutter speed set on camera	1	1/2	1/4	1/8	1/15	1/30	1/60
Actual shutter speed	60	30	15	$7\frac{1}{2}$	4	2	1

Flash

Electronic flash is synchronized through a 3 mm (PC) contact on the side of the camera body. This has a friction lock which requires a little pressure to fit the cable. The flash must fire when the entire film area is uncovered. This happens at speeds of 1/90 sec (represented by the red X on the shutter-speed ring) and longer. To avoid errors, the flash is fired only when the shutter speed is set at speeds of up to 1/90 sec. When set to higher speeds, the flash does not fire.

For flash synchronization at shutter speed up to 1/500 sec, mount a lens with Compur shutter on the camera and connect the flash cord to the sync contact on the lens.

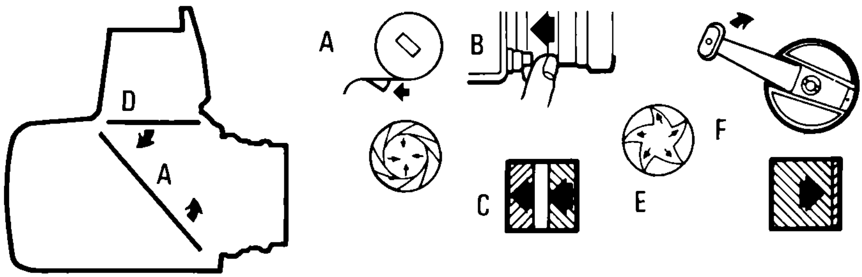
Programming the mirror operation

The 2000FC mirror can be made to operate in three different ways by turning the slotted chrome disc in the winding crank with a coin so the slot points either to 1, 2 or 0.

At setting 1, the mirror is raised when the release is depressed and it stays there until the winding crank is turned. By looking on the ground glass, therefore, you know whether the camera is ready for shooting (when an image appears) or whether it is released or prereleased (when the image is blacked out). This mirror operation is therefore like the 500C/M, except that the mirror in the 2000FC returns the moment the crank is turned rather than at the end of the turn.

The diaphragm in F lenses also opens when the mirror flips down. When C lenses are used, the mirror returns as you start turning the crank but the lens shutter and aperture do not open until the turn on the crank is completed.

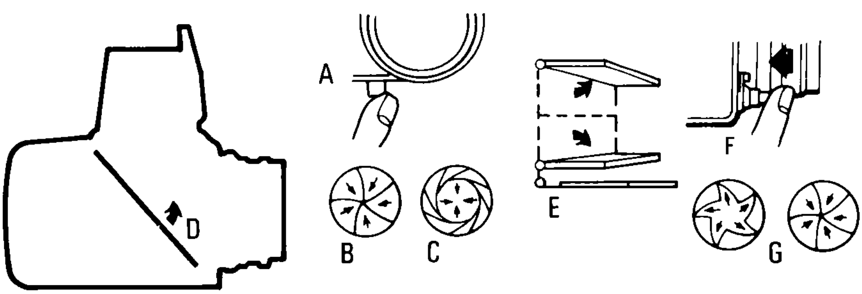
At setting 2, the mirror returns instantly and automatically to the viewing position as soon as the focal-plane shutter has completed the exposure. The instant-return mirror shows the subject after the exposure is made, but it does not show the subject on the ground glass when the image is made. To see the subject at that moment, you need a sports finder or an optical finder (like the one on the SWC) that has uninterrupted viewing. While the mirror set to position 2 always returns the moment the focal-plane shutter closes, the ground-glass image is not restored instantly when C lenses are used, whether the lens or the focal-plane shutter is used. The lens shutter and diaphragm do not open until the crank is turned.



Release cycles on the 2000FC

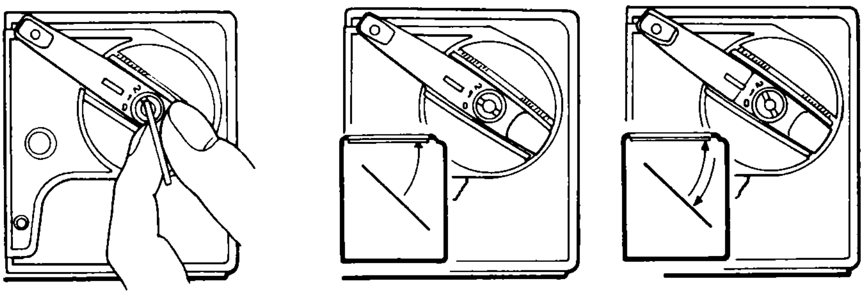
Prerelease cycles. When the Compur shutter is used, the prerelease cycle is identical to that on the 500C/M except that the focal-plane shutter replaces the auxiliary shutter. With F lenses without shutter and with the mirror set for instant return, prereleasing only lifts the mirror and closes the diaphragm to the preset aperture (A). When the camera release is depressed (B), the focal-plane shutter opens and closes to make the exposure (C), the mirror then flips down (D) and the diaphragm opens fully (E). An image at full brightness is therefore visible on the ground glass immediately after the exposure has been made. When the winding crank is turned, the focal-plane shutter is recocked and the film advanced.

Release cycle. When the prerelease is not used the sequence is the same except that the mirror is flipped up and the lens diaphragm stopped down by pressure on the release button. Set to position 1, the mirror flips down and the lens diaphragm opens when the winding crank is turned.

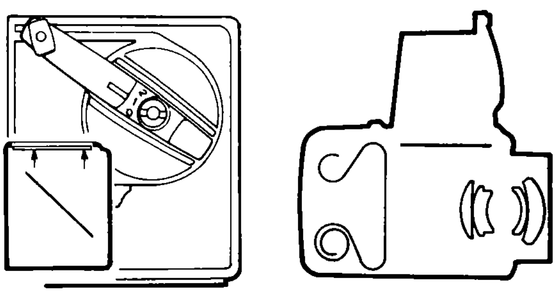


Prerelease on the 500C/M and 500EL/M

Prereleasing (A) the 500C/M or 500EL/M causes the lens shutter to close (B), the lens diaphragm to stop down to the preset aperture (C), the mirror to lift up (D) and the auxiliary shutter to open (E). When the release is depressed (F), only the lens shutter opens and closes (G) to make the exposure.



The mirror programme disc
The mirror motion is changed by turning the slotted chrome disc to one of the settings 0, 1 or 2 with a coin.
When the programme disc is set to 1 (*centre*), the mirror swings down the moment the winding crank is turned. It is similar to the mirror operation in the other Hasselblad cameras.
Position 2 (*right*) is the instant return position. The mirror moves down the moment the exposure is completed.



In position O, the mirror is locked in the up position, and never moves down. Thus, in this position, lenses that penetrate the camera body can be used.

At setting 0 the mirror is locked in the raised position and never moves. The mirror, however, does not flip up when the button is moved from 1 to 0. It only stays in the up position after the exposure has been made. To have the mirror up right away, push the prerelease button.

The mirror-lock position has several uses. Firstly it eliminates the mirror movement at the moment the exposure is made, although the prerelease is much more practical for this purpose. Having the mirror locked also allows the use of special lenses which may project into the camera body.

Position 0 is also useful when the ground glass is not used for viewing. In photomicrography, for instance, a special viewing eyepiece is used for

framing and focusing. Another case is when the camera is a fixed part of a set-up for surveyance, on an oscilloscope, or combined with any other instrument.

This setting must be used when the camera is operated by an electrical triggering device connected to the battery compartment. In this application the lens diaphragm must also be locked at the selected *f* stop using the manual stop-down control.

While the selector disc can be turned to 0, 1 or 2 at any time, whether the camera is released, prereleased or not released, it is best to set it to the desired position with the camera in the triggered position.

The mirror of the 2000FC is considerably longer than in the other cameras to allow full-screen viewing with all lenses and accessories. In the lowered position the bottom edge almost reaches the inside bottom of the camera. To avoid the rear of the lens, the mirror moves upwards before and while it swings up. The bottom edge follows an S-shaped curve as it swings up.

Winding crank operation

With the winding crank on the 2000FC you can either recock the shutter and advance the film or recock the shutter without advancing the film. The film is advanced when a normal full turn is made on the crank with the handle folded out or in. So both operating signals in the camera and the magazine change from red to white. The film is not advanced when the slotted chrome program disc in the center of the crank is depressed when you start turning the crank. Only the camera signal changes to white. The magazine signal remains red.

The easiest way to operate the crank without advancing the film is to depress the program disc with the right index finger, then start turning the crank with the right thumb. The disc needs to be depressed only at the moment you start turning the crank, not for the complete turn.

The feature is also useful when the camera has been prereleased and you need to see the image on the ground glass once more before the picture is made. A turn on the crank with the program disc depressed does this.

9

Viewing and Focusing

CAMERA STEADINESS IS the first requirement for image sharpness—accurate focusing of the lens the second. To make lens focusing and framing of the image as accurate and convenient as possible in all lighting conditions, at all distances, with all lenses and accessories and with the camera held in different ways, Hasselblad ground-glass screens and finders are interchangeable. On the 2000FC, 500C/M, 500EL/M you can change from one type of screen or from one viewer to another in the middle of a job or of a roll of film.

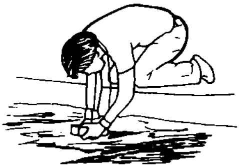
Ground-glass screens

Choice of screen is mainly personal. Check the different screens to determine which is best for your eyesight and for the lighting conditions, lenses and accessories you use most. This is especially important if the screen is permanently installed in the camera, as is necessary on the older Hasselblad models.

The *standard plain ground-glass screen* is considered the most satisfactory by many photographers. It provides an image which, with the exception of four fine black lines, is uninterrupted by circles and clear areas making it the best choice for evaluating the final effectiveness of the image. It is equipped with a Fresnel lens for best corner brightness. On the other hand, seeing whether the image formed by the lens falls accurately in the plane of the screen is not as easy with a plain screen as it is with other types. For this reason, microprisms and split image rangefinders have become very popular.

Fine line focusing screen

On the standard ground-glass screen, the fresnel lines are spaced 8 per millimetre which is best for focusing most subjects. On the fine line focusing screen the lines are more closely spaced (13.3 per millimetre) so they are less obvious



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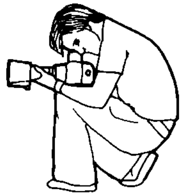

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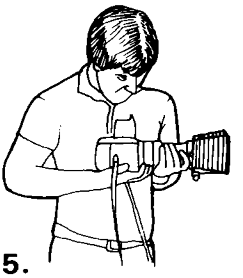

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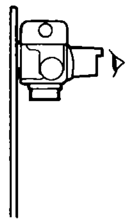

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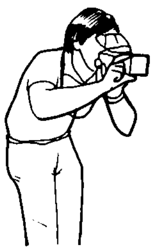
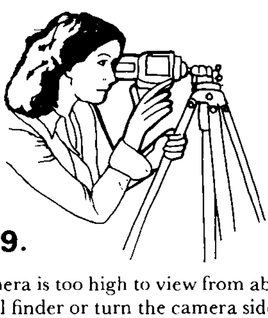
Viewing from the top has great advantages when photographing, for example, from low angles (**1**), from the knee (**2**), straight down (**3**), from over the head (**4**), sideways (**5**) or from a vertically mounted camera (**6**).



7.

8.

Holding the camera in the hand (**7**) complicates communication with your subject. A tripod-mounted camera, on the other hand, leaves you free to direct the people being photographed as your eye need no longer be glued to the viewfinder (**8**).



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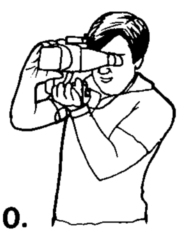


10.

When the camera is too high to view from above and it is inconvenient to view from below, either use an eyelevel finder or turn the camera sideways and view from the side (**9**).

For the $4\frac{1}{2} \times 6$ format, a 90° finder and a flashgun bracket allow steady and convenient holding and viewing for both the vertical and horizontal arrangements (**10**).

and very fine detailed subjects are easier to focus on, particularly in macro and micro work. Both screens are equally bright.

Split-image rangefinder

With the split-image focusing screen, the image can be focused either in the clear 7.5 mm rangefinder centre circle or on the surrounding ground-glass area. The subject is in focus when a straight line crossing the rangefinder area appears unbroken across the dividing centre line. This is easy to see even when the image is not quite sharp.

The screen can be inserted in the camera with the dividing line running horizontally or vertically. For focusing, the camera must be aimed at the main subject, perhaps an inconvenience in action photography or when photographing moving subjects in general.

The main limitation of the split-image rangefinder screen involves lenses. When the aperture of the lens is smaller than *f*4, one or other side of the split-image rangefinder field blacks out. The rangefinder prism screen should, therefore, not be considered when you use *f*5.6 or *f*8 lenses, such as the S-Planar 120 mm, Sonnar 250 mm, Tele-Tessars 350 and 500 mm, the 140–280 mm Schneider Variogon. It also means that focusing is not possible with a lens manually stopped down, although this, of course, is not recommended as focusing is always most accurate with the lens aperture wide open providing the brightest image with the minimum depth of field.

With *f*4 or faster lenses, both fields of the split-image rangefinder are clear only when your eye is in the optical axis. If one of the fields is blacked out, move your eye slightly up, down or sideways.

Central grid

The central grid is a relatively large microprism focusing area in the centre of the screen. It is much brighter than the ground-glass area, which is an advantage when working in low light levels. The corners of the screen, on the other hand, are somewhat darker.

The microprism grid must be aimed at the subject for focusing but its diameter is twice as large (15 mm) as the split-image rangefinder. As the name indicates, the centre area consists of many tiny prisms which split lines if the lens is not focused at the proper distance. Microprisms appear easier for focusing as the image seems to 'jump' more readily and rapidly into place than it does on the standard screen.

The screens with microprism centres can be used with lenses of all focal lengths and apertures, and consequently, focusing can also be done with the lens stopped down.

Checked screen with central grid

The ground-glass screen with 15 mm microprism centre is also available with engraved horizontal and vertical guiding lines. These are helpful when the subject lines have to be parallel to the edges of the image as in architectural photography, product photography, when photographing documents, charts, titles, or even in outdoor photography, to ensure a straight horizon line, etc. The microprism centre is identical to the one without checked lines.

The checked screen has another important application as a cropping guide when magazine 16 or 16S is used and when 6 cm ($2\frac{1}{4}$ in) square negative images are to be printed as verticals or horizontals. The engraved lines are spaced so that the two vertical and the two horizontal outside lines correspond to the 8 × 10 in paper ratio. The centre square between the vertical and horizontal lines corresponds to the Superslide format.

To make the 8 × 10 in area more pronounced, you can darken the four corners with black lacquer or cement a grey filter foil over it. A screen mask of this type shows both the vertical and horizontal 8 × 10 in as well as the Superslide area.

Ground-glass masks

The 4.5 × 6 cm ($1\frac{5}{8} \times 2\frac{1}{4}$ in) image of the magazine 16 and the Superslide area of magazine 16S can be masked off on all ground-glass screens with a transparent focusing screen mask which is simply placed on top of the ground-glass screen. There are two versions: one with side cutouts for the screen-retaining clips of the newer cameras with interchangeable screens, and one without cutouts for the older models. The mask can, of course, also be used as an 8 × 10 in cropping guide when images are made in the square format on the film.

The mask is made transparent so that it can be used with the meter prism without the need of an exposure compensation. However, being clear plastic, the image area is not too clearly defined.

Screen mask

For producing Superslides, a black focusing screen mask is also available. It drops on top of any of the ground glass screens. You only see what is covered by magazine 16S, without being influenced by the surrounding area. For accuracy in framing, and evaluating the composition and effectiveness of the Superslide, it is an unquestionable advantage. The disadvantage is that the meterprism cannot be used for light measuring, as the mask covers the EV scale.

Checked screen

The checked screen, made for cameras without interchangeable screens, allows you to see the magazine 16 and 16S image area and have guidelines for horizontal and vertical objects. It is also placed on top of the ground glass and can, therefore, be used with all focusing screens. The checked screen gives owners of older cameras the opportunity to have the vertical and horizontal guidelines without having another screen installed. The corners could be darkened to enhance the 4.5×6 cm ($1\frac{5}{8} \times 2\frac{1}{4}$ in) image areas. The checked screen can be used on the viewer cameras if the cutouts are made with a suitable cutting tool.

Screen and masks with the meter prism

The reading on the meter prism varies less than half an *f* stop with the various ground-glass screens. The meter reading should, therefore, be correct with all screens and without making an adjustment on the meter. The transparent masks do not affect the meter reading.

Cleaning focusing screens

Standard focusing screen. The ground-glass screen is made from glass and the *top* surface is therefore cleaned like a lens. The Fresnel lens under the focusing screen is made of plastic and is, therefore, soft and liable to scratching. Blow and brush only. If necessary wipe gently with a soft cloth and water.

Other ground-glass screens. All other ground-glass screens, the transparent masks and the checked screen are made of plastic and, if at all possible, should be cleaned by brushing and blowing only. They should be wiped only if absolutely necessary and if so, very gently with a soft cloth, perhaps slightly moistened with water.

Installing screens on older cameras

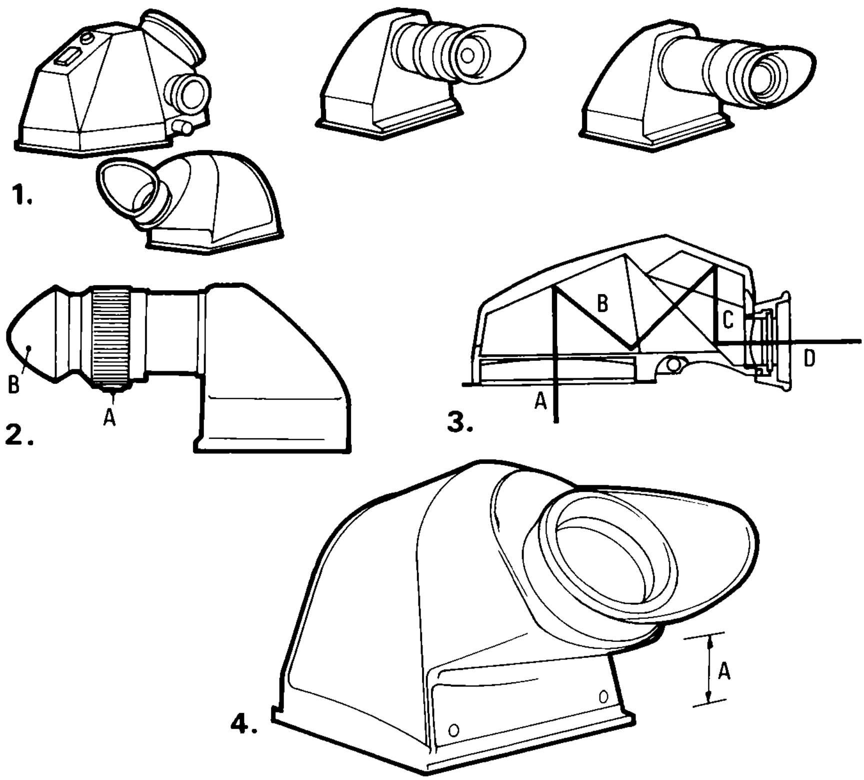
500C cameras below number US 106701 and 500EL cameras below number USE 15075, which do not offer screen interchangeability, can be equipped with other screens at a Hasselblad Service Centre. The change is not difficult, but the new screen must be aligned precisely to assure accuracy in focusing. This cannot be done without special instruments.

Viewfinders

The interchangeable Hasselblad viewfinders serve basically two purposes: to magnify the image on the screen for more accurate focusing; and to shield the screen from extraneous light and thereby make it easier to see the image

from corner to corner, even in bright sunlight. All the Hasselblad viewfinders can also be used on the 1000F, and 1600F models.

All viewfinders are suitable for viewing and focusing, but each has its own advantages. It is best to first select a finder which allows convenient use of the camera for your type and method of photography and with the lenses you usually use. If you do a lot of hand-held photography, select a finder which allows steady and convenient holding of the camera.



The Hasselblad viewfinders
1 (*Left to right*). The meter prism and NC-2 prism finders both have 45° viewing. The HC-4 and the HC-3/70 are both for 90° viewing from behind the camera and have an ocular focusable + 5 dioptres. They are best adjusted without a lens on the camera (**2**). Turn the dioptre correction ring until the ground-glass image is seen sharply and lock the ring in that position with screw A. The rubber eyepiece can be rotated for right or left eye viewing.
3 The HC-1 viewfinder was the first 90° viewfinder for Hasselblad. Its flat design made the prism-equipped Hasselblad into a compact camera for eyelevel viewing with a $2\frac{1}{2}\times$ magnification. As the finder protrudes beyond the camera body, the Polaroid magazine cannot be used which is one of the reasons why it was superseded by the HC-4. Correction lenses can be installed.
4 The 1980 version of the NC-2 viewfinder is cut deeper underneath the eyepiece (A) to clear the Polaroid back.

Viewfinders to improve camera steadiness

Movement is eliminated or reduced when two forces work against each other. With a hand-held camera the two forces are the hands pressing the camera in one direction and the photographer's head, with the eye pressed against the viewfinder, pushing the opposite way. All Hasselblad viewfinders can be used in this way. The viewfinder and its eyepiece is, therefore, used not only for viewing, it is used for holding and steadying the camera. A firm contact between eye and viewfinder is a necessity. For this reason, all Hasselblad finders (except the standard finder) are equipped with large, comfortable rubber eyepieces.

This firm contact is lost when spectacles are worn. They also prevent you from placing your eye right behind the eyepiece; as a result you may not be able to see the entire ground-glass screen area and light from behind may flare on the screen, reducing image contrast.

Viewfinders for accurate focusing

Besides convenient corner-to-corner evaluation of the image, the viewfinders must show exactly and quickly when the lens is set at the correct distance. To do that, you must be able to see the screen sharply; focusing problems become more obvious at low light levels, so if you find you have trouble then you probably need to think about eyesight correction for your photography.

Viewing through the magnifying lens of the standard finder is like viewing nearby. If you wear glasses for reading, the same glasses will probably give a sharp image through the magnifying lens. If viewing with eyeglasses, however, the standard finder is almost impossible to use. One solution is to focus through the magnifying lens with the eyeglasses on, then lower the magnifier and compose the image by viewing the screen direct. Another, and generally better, solution is to consider switching to a prism viewfinder with an adjustable diopter correction eyepiece.

Go to a photo dealer or friend who has a Hasselblad finder with an adjustable eyepiece such as the magnifying hood or, preferably, the HC-4 or the HC 3/70 prism finder. Check whether an adjustment on the eyepiece diopter ring gives a sharper image than you usually see. If so, consider switching. Before doing so, or in addition to it, also investigate switching to another ground glass screen. The split-image rangefinder or the microprism may give you the necessary focusing accuracy.

Adjusting the correcting eyepiece

Turning the correcting eyepiece of a prism viewfinder is like putting different eyeglass lenses in front of the eyes. Turning the ring to + 1, for instance, is like viewing through a + 1 diopter eyeglass lens. Adjusting the eyepiece has absolutely nothing to do with focusing the lens, or with photographing at

different distances. The adjustment is therefore best made without a lens on the camera. Point the camera without lens at a bright area and turn the diopter ring until the grain on the ground glass or the engraved lines appears absolutely sharp. After adjusting, take the eye away from the finder, view a subject at infinity and recheck the adjustment once more to see if it is still sharp. This assures that the eyepiece is adjusted for a relaxed eye (viewing at infinity). This adjustment is made once only and the ring then locked. It is not changed when switching lenses or taking pictures at different distances. The correction eyepiece needs changing when someone with a different eyesight uses the same finder, or perhaps after a few years when the eyesight has changed enough.

Eyepiece correction lenses

The 45° viewfinders and the older 90° HC-1 finder do not have adjustable eyepieces but they can be equipped with correction lenses which have the same effect as adjusting the diopter correcting eyepiece. It is best to have a lens made by a suitable eye specialist, and fitted by him or by your Hasselblad dealer. The 45° finders use 24.5 mm diameter lenses, and the HC-1 19–20 mm. The retaining ring to hold the lens in place is in the newer finder and can be removed with a spanner. On older NC-2 finders, the entire eyepiece must be changed because there is no retaining ring.

The Hasselblad 45° finders form an image at 1.5 m (5 ft), the HC-1 at 3 to 3.5 m (10 to 12 ft). This means that the correction lens that is installed must give a sharp image with your eyes in the relaxed position at the above mentioned distances. Keep in mind that eyes change and correction lenses may also need a change after a few years.

Area coverage on ground glass

The image seen on the ground glass of the Hasselblad cameras, or the groundglass back when attached to the rear of the camera, corresponds to the area covered on the film.

Vignetting

When long focal length lenses, extension tubes or bellows are employed on the 500C/M and 500EL/M models, vignetting may be noted in the upper part of the viewfinder image. This results because the mirror size is restricted by the distance that the 80 mm Planar extends into the camera so that some of the light from distant optical elements passes below its bottom edge. This image cut off only happens on the focusing screen, not on the film and one must, therefore, allow for it. Move the camera slightly upward to see what is in the cut-off area and make certain there is nothing there that should not be in the image. The S-curve mirror motion has eliminated this problem on the 2000FC.

Standard viewfinder

The standard viewfinder has three advantages:

1. It makes the camera most compact for carrying, since the finder is foldable.
2. It provides the highest magnification of the ground-glass image.
3. It allows viewing the ground glass from a distance (by not using the magnifying lens).

The only prism viewfinder that offers about the same magnification (4 ×) is the 90° prism finder, HC-3/70, designed for use with the magazine 70. For viewing from above with the highest magnification the standard finder is the choice. However, it is not too comfortable when pressed into the eyeball. From this point of view the magnifying hood with its rubber eyecup is a better choice. Also, you may not be able to see a sharp image, especially if you wear glasses for reading. You can glue a thin correction lens over the top of the existing lens, but it is not easy to find a suitable lens and glue to hold it.

Hand-held shooting with eyeglasses and the magnifying lens cannot be recommended as camera steadiness becomes questionable with the glasses rubbing against the viewfinder frame.

As the standard finder allows viewing of the focusing screen with the naked eye (without a magnifying lens), it is the ideal choice when the ground glass must be viewed from a distance. This is, for instance, the case when photographing from waist or ground level, with the camera held above the head (upside down).

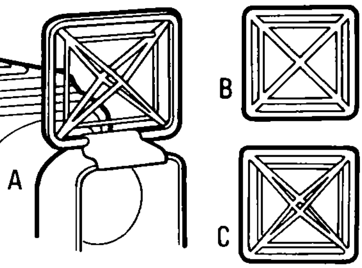
The standard finder and the magnifying hood can be used with all film magazines including those for Polaroid film.

Magnifying hood

The magnifying hood solves the eyeglass correction problem of the standard finder. It has an eyepiece adjustable from −2.5 to +3.5 diopters. The magnifying hood has a soft rubber eyecup to keep out extraneous light and to provide comfortable viewing when the camera is pressed against the face for steadiness.

Advantages of viewing from the top

While eye-level viewing with prism viewfinders has become almost the accepted standard for hand-held cameras, especially in 35 mm, much can be said in favour of viewing from the top. It offers most convenient viewing at low camera angles. Focusing and framing is done easily, even if the camera is on the floor or ground, and without the photographer having to lie on the floor himself, which is especially appreciated in snow or slush. In a nightclub or restaurant, for instance, you can place the camera on the table and view the image on the ground glass, without anyone being aware of it. When kneeling down you can photograph with the camera on your knee for steadiness. You



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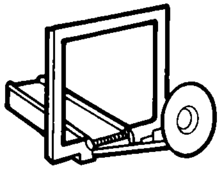

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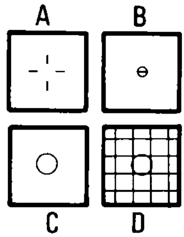
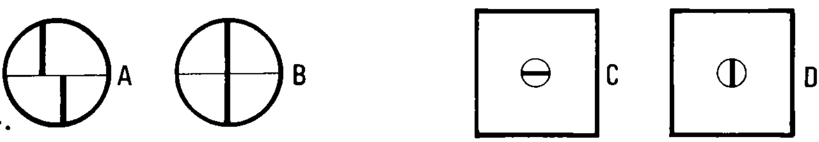


3.

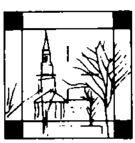
The frame finder (1) fits on top of the square lens shades (A). The larger square shows the image area when the 150 mm lens is used, the smaller square that with the 250 mm lens. The eye is properly positioned when the two sets of diagonals (C) coincide so you see only one set (B). The sports viewfinder (2) slides on the accessory rail on the side of the camera. Masks to show the various image areas with different magazines and lenses are available.

A variety of ground-glass screens (3) are available for the Hasselblad: the plain ground-glass screen (A) which may have a split-image rangefinder (B), the microprism screen (C) and the combination of microprism and checked screen (D).

4.



Accurate focusing with the split image rangefinder screen (4) is obtained when a straight line in the subject crossing the split is not broken (A) but continuous (B). The screen can be placed in the camera so the split is horizontal (C) or vertical (D).



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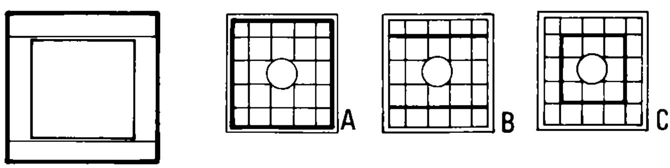


6.

5 When photographing in the 6 × 6 square format but intending to crop later to the 8 × 10 format, darkening the corners of the checked screen with black lacquer can assist in composing the picture.
6 The checked screen and microprism with checked screen can also be used for framing the 8 × 10 format or the Superslide format; the engraved lines mark the edge of the image on magazines 16(B) and 16S(C).

look right at the ground glass from the normal working position when the camera is mounted on a copy stand or microscope.

If the tripod-mounted Hasselblad is too high for viewing from the top and an eyelevel surface is not available, tilt the tripod head 90° to the side so that the ground glass can be seen from the side—no problem with the square format camera. This camera position also allows you to see the lens controls.

Candid photography of people, without them being aware of the photographer, is frequently more successful with the camera turned to the left or right instead of straight ahead. Just turn the Hasselblad sideways and view and focus with the standard finder or magnifying hood.

The ground-glass image seen with the standard finder or magnifying hood is right side up, but reversed sideways. What is left is seen as right, what is right as left. This is never a problem in focusing and seldom a serious problem in framing once you are used to the camera. It becomes a problem, however, when you want to follow moving subjects as in sports or wildlife photography. You invariably move the camera to the wrong side, probably missing an important shot as the subject has long moved out of the frame by the time you are ready to take the picture.

90° eyelevel viewing

For viewing and focusing from eyelevel, or even somewhat higher, the 90° eyelevel finders are the best solution. There are two Hasselblad models available, one with a short viewing tube (HC-4) for the regular roll film magazines, and one with a longer tube (HC-3/70) to bring the eyepiece behind the larger magazine 70. The latter can also be used with the roll film magazines, but viewing is not as convenient and camera steadiness may suffer as only the eyepiece rests against the photographer's face. With the shorter tube the camera can be pressed against the cheek like a 35 mm camera.

The HC-3/70, however, offers a higher magnification of 4 ×, about the same as the standard finder, while the HC-4 is 3 × only. Both have an adjustable diopter correcting eyepiece from +5 to −5 which is sufficient for most eyeglass wearers. The viewing tube on both finders is raised above the camera to clear the Polaroid magazines. The 90° finder must be considered for taking vertical pictures with magazine 16.

45° eyelevel viewing

Two finders with 45° viewing are available, one with a built-in meter, one without. The meter prism finder is somewhat bulkier, but as far as viewing magnification is concerned, the two are identical. The prism viewfinders with 45° viewing are a good compromise between the standard and the 90° finders. You can hold the camera extremely steady as your hands normally press the camera diagonally upwards towards your slightly tilted head.

Viewing is very comfortable from eyelevel and possible from fairly low and high angles. The finders are equipped with comfortable and well-cushioned rubber eyepieces which allow viewing with or without eyeglasses. With glasses, however, your eye may be too far from the eyepiece to see the entire ground-glass area. There is no built in diopter correction, but you can add correction lenses. The magnification with both 45° finders is 3× (the same as the 90° HC-4): higher than the magnifying hood but less than the standard finder or the 90° HC-3/70.

The NC-2 made up to 1980 and all meter prism viewfinders made up to 1981 must be removed when using the Polaroid back. The 1980 version of the NC-2 and the silicon cell meter prism introduced in 1981 are cut deeper underneath the eyepiece to clear the Polaroid back.

Frame and sports viewfinders

When the speed-up release (prerelease) is depressed, the ground-glass image disappears. Framing the subject with a hand-held camera is still possible with the frame or sports finders, which are ideal for following a moving subject because you can see more than the area included on the film. You can see what exists and what is happening outside the area, and whether a subject is about to move into the picture. When panning with the camera, you can see where the camera is moving to, how far to move it and when to press the release. In low light levels, a sports or frame finder shows the view as brightly as it is seen with the naked eye, without the grain of the ground glass between the viewer and the subject.

The frame viewfinder

The frame viewfinder mounts on the square sunshades. It has two square frames, the smaller shows the field of view covered by a 250 mm lens with the 2¼ in square magazine, the larger is for the 150 mm lens. The 150 mm frame is also about equal to the area coverage of the 100 mm lens combined with Superslide magazine. Since the frame finder was made mainly for sports photography it has no parallax correction for close subjects. As with all mechanical frames and sports finders, proper framing requires the eye to be in the centre of the optical axis. The frame finder has two 'crosshairs' approximately 1 in apart for this purpose. The eye is in the correct optical path when one cross completely covers the other. A special frame finder is also available for 350 mm and 500 mm lenses.

The sports viewfinder

The sports viewfinder slides into the accessory rail on the side of the Hasselblad SLR cameras. It can be folded together on or off the camera. The eyecup ensures centering. To ensure reasonably accurate framing not only at infinity

SUMMARY OF HASSELBLAD VIEWFINDERS

Type	Magnification	Viewing angle	Image	Eyepiece adjustment	With Polaroid magazine	Main advantages and applications
Standard finder		down	Reversed	Fixed	Usable	High magnification, compact, good for low angle photography
Magnifying hood	$2\frac{1}{2}\times$	down	Reversed	Adjustable $+3.5$ to -2.5	Usable	Diopter correction, comfortable viewing
HC-4 prism finder	$3\times$	90°	Correct	Adjustable $+5$ to -5	Usable	Diopter correction, eyelevel photography, usable with Polaroid magazine but not magazine 70
HC-3/70 prism finder	$4\times$	90°	Correct	Adjustable $+5$ to -5	Usable	High magnification, diopter correction for eyelevel photography, usable with magazine 70 and Polaroid back
NC-2 prism finder	$3\times$	45°	Correct	Fixed—install correction lens	Not usable except latest 1980 model	Eyelevel photography, relatively compact, usable with magazine 70
Meterprism finder	$3\times$	45°	Correct	Fixed—install correction lens	Not usable except latest 1981 model	Through-the-lens metering, eyelevel photography, usable with magazine 70

but at closer distances as well, you can move the eyepiece section for parallax correction. The sports finder by itself shows the area of the 80 mm lens in combination with a $2\frac{1}{4}$ in square magazine, or of the 60 mm lens when using the magazine 16S for Superslides.

Masks can be inserted to show the field of view of: lenses from 100 mm to 500 mm with a $2\frac{1}{4}$ in square magazine; lenses from 80 mm to 250 mm with magazine 16; and, 80 and 150 mm lenses with magazine 16S. All masks are transparent so you can see the surrounding area.

Cleaning viewfinders

Viewing hood magnifiers. The magnifying lens is in an exposed position, and grains of sand and dust can accumulate in the hood crevices. Be certain to blow and brush away all dust particles before wiping with lens tissue, and if necessary, lens cleaner.

Prism viewfinders. The eyepiece lens is cleaned like other lenses, with a brush or blower and if necessary by wiping the lens gently with lens tissue and a small amount of lens cleaner. The same approach can be used on the bottom prism surface on all finders except the meterprism. The field lens of the meterprism finder is made of plastic and can easily be scratched. So never use a polishing cloth or lens cleaning fluid or any other solvents. Just blow and brush off the dust. Only if absolutely necessary should it be wiped gently with a soft cloth, slightly moistened with water. Off the camera, the prism viewfinders should always be protected with the cover that slides over the bottom plate.

10

Exposure Metering

THE TECHNICAL QUALITY of photographic images is determined mainly by sharpness and exposure. Exposure is determined by the amount of light, the sensitivity of the film, the lens aperture and the shutter speed. The amount of light is usually predetermined, the sensitivity of the film is decided by our choice of film, which leaves two major controls for exposure, the aperture and the shutter speed. The two must be set so that the proper amount of light reaches the film in the camera.

All light meters made by all companies produce good results if used properly. More important than the make is the metering method that you use. You must learn in detail how the meter measures the light and how it must be used to provide the best results in all situations.

Incident light meters

There are two basic methods of measuring light levels for photographic purposes. In one method, known as incident reading, the meter measures the light *falling on* the subject.

The cell of the meter is usually covered with a dome-like diffusion disc. Many hand-held reflected light meters can be used for measuring incident light by sliding or attaching a diffusion disc over the cell. The Hasselblad exposure meter knob is of this type. The meter is held in front of the subject with the cell facing towards the camera, or sometimes facing in a direction between the camera and the main light. The meter reading is unaffected by the tone of the subject, and thus produces the most accurate exposure measurements.

Meters offering a choice of reflected or incident readings are the best choice for the photographer who fully understands light and light measurement, but not for the photographer who may fall into the habit of measuring everything both ways, comparing the values and compromising between the

two. It is not a recommended approach, and is usually practised only by a photographer who does not understand light and exposure.

Reflected light meters

In the second method, the meter measures the light *reflected from* the subject, it measures the brightness of the subject as the lens sees it. The meter reading, therefore, depends on two factors: the amount of light that falls on the subject and the amount of light reflected back from the subject. A light subject gives a higher reading than a dark subject even though they are lit in the same way. A reflected light meter is pointed at the subject from the direction the picture is taken.

Hand-held reflected light meters

Hand-held reflected light meters come in two basic types. The first has a measuring angle that is approximately equal to the standard lens on the camera. The Hasselblad meter knob works like this. The second type is the spot meter. It has a narrow measuring angle of a few degrees only and measures a small area determined by looking through a finder in the meter. The two, therefore, differ not in the way the light is measured but *in the area* that is measured.

With a spot meter you can measure one specific small area, or several areas within a scene, from the camera position, which is obviously an advantage. On the other hand, you can make very serious exposure mistakes by measuring the wrong 'spot' within a scene. Spot metering requires a more thorough knowledge of light measuring than a regular meter.

Built-in meters

Many modern cameras have light meters built into the camera or into an accessory such as the Hasselblad meter prism. Such meters measure the light reflected off the subject, but they measure it through the camera lens which has a few advantages. The viewfinder shows you exactly what area is measured and, when the lens is changed, the measuring angle of the meter also changes. This is especially valuable when working at longer focal lengths and photographing distant subjects which may not permit a close-up reading with a separate meter. As the meter is part of the viewfinder, changes in brightness can be seen while viewing the subject. The light is also measured through any accessories you place in front of the lens (such as filters) or any accessories placed between lens and film (such as extension tubes and bellows). Built-in meters, therefore, provide exposure readings which do not require consideration of filter or exposure factors.

As a convenience, consider the fact that a built-in meter eliminates the

need for carrying a separate meter. On the other hand, a repair of the meter also requires giving up the camera. Should the Hasselblad meter prism require service, you can, naturally, change to one of the other finders and continue using this camera.

While all built-in meters measure the light through the lens, they can measure it in different ways. The meter may measure the entire area seen in the finder equally from centre to corner—the averaging method. It is the same as measuring with a separate meter. There are also built-in meters that work more like a spot meter, measuring only a certain area of the viewfinder image. The area may be in the centre of somewhere else. A third method is known as the centre-weighted method, a compromise between the other two. The meter measures the entire ground-glass area but it favours the centre (or quite often the lower centre). The Hasselblad meter prism is based on a centre-weighted measuring principle, measuring approximately 50% of the light within the 25 mm (1 in) centre area.

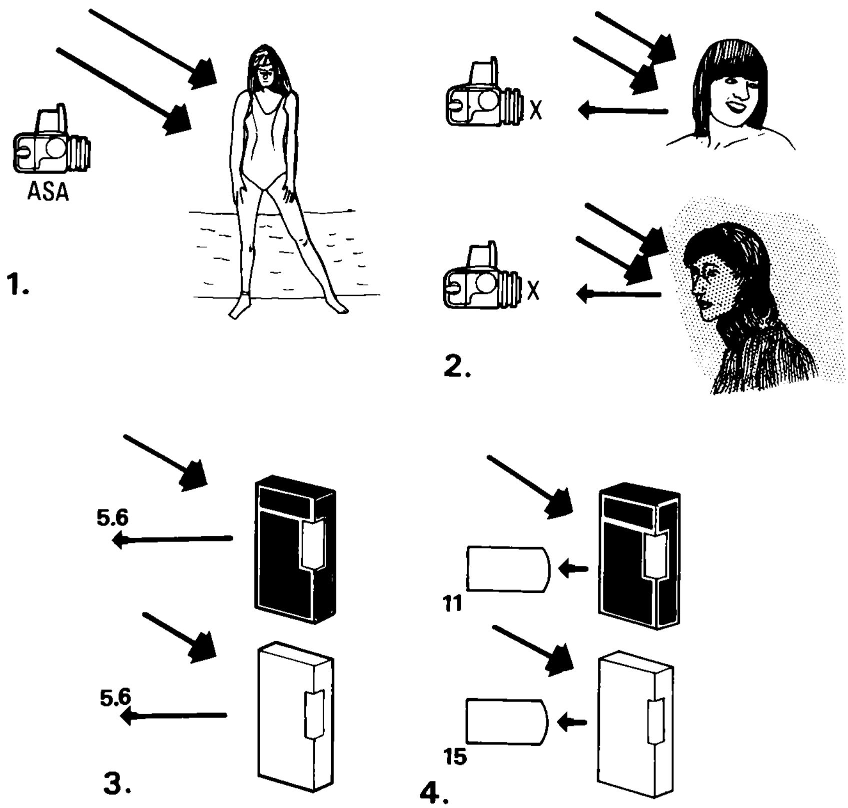
Built-in meters do have advantages but they do not automatically provide correct exposure. Their readings are correct only if they are used properly—and to use them properly you must realize they are measuring the light reflected off the subject and they must be used as any other reflected light meter.

Reflected light meter readings

To understand reflected light metering you must realize that the lens settings for correct exposure are determined only by the amount of light that *falls on* the subject. The lens setting, therefore, should be the same whether you photograph a white or yellow subject, or one that is black or dark brown, green, blue, or red. So, reflected light readings cannot be correct in many cases, because they depend on how much light is reflected back from the subject. A reflected light meter reading is high for white or yellow subjects, low for black or dark brown and somewhere in between the two for green, blue and red. Which is correct?

The green is most likely to be correct because green reflects about 18% of light. Every reflected light meter is adjusted for an 18% reflectance. This applies to the Hasselblad meter knob, meterprism and every other reflected light meter, separate or built-in. Every time you point the meter at a subject, it 'assumes' that the light it measures is reflected off an 18% reflectance subject, and the reading it shows is *correct* only when you measure an 18% reflectance. If the measured subject reflects more or less, you must make the necessary adjustment. If you do not, neither the black nor the white subject is recorded as black or white; both are recorded as grey. So before you take the reading off a reflected meter ask yourself if you have measured something that reflects about 18% of the light—if so, use the reading as it is.

Surprisingly, most ordinary scenes reflect about 18% of the light that



Correct lens settings for exposure are determined by the sensitivity film in the camera and the amount of light (**1**).
Incident light readings. If the amount of light falling on the subject requires a lens setting of X, this setting should be used whether the subject is light or dark (**2**). For example, a black or white lighter, under the same lighting, will require an aperture of 5.6 and the same shutter speed (**3**).
Reflected light readings. Reflected light meters measure the amount of light reflected off the subject and therefore give different readings for different coloured and surfaced subjects (**4**).

falls on them. So you need correct only rarely. Some typical 18% reflectance subjects are green fields and trees, brown earth, fall foliage, blue skies, sun-tanned faces. If the reflected meter reading is taken off a brighter subject which reflects much more than 18%, set the lens at an aperture or EV setting one or two stops larger (*f*8 instead of *f*11; EV 10 instead of 11). *Open* the lens for lighter subjects. Some typical subjects requiring such an adjustment are: fog, 1 EV number; sand, $1\frac{1}{2}$; snow, $1\frac{1}{2}$–2; white flesh tones, 1; overcast skies, 2; reading off the palm of the hand, 1. In all cases *open* the lens for these lighter subjects.

For subjects that reflect much less than 18%, *close* down the lens, for example: a blackboard, 2 *f* stops or EV numbers; black flesh tones, $1-1\frac{1}{2}$.

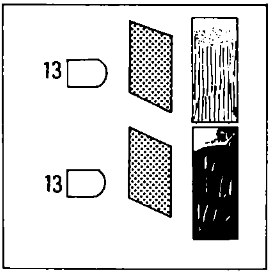
It seems to confuse many photographers that the aperture must be opened when reading bright subjects and closed for dark ones. To demonstrate this point consider the following example: A reflected meter reading of a subject with an 18% reflectance is EV 14, requiring settings of 1/250 second and *f* 11. A reading off a white subject would be EV 16 or 1/250 sec at *f* 22. To bring it to the correct 18% reflectance reading, change it down to EV 14 which means opening the aperture 2 *f* stops from *f* 22 to *f* 11. A reading off a black subject would be lower, perhaps EV 12 or 1/250 sec at *f* 5.6. The necessary correction means adjusting to the higher EV of 14 or closing the aperture down to *f* 11.

Incident light measuring

As an incident meter measures the light falling on the subject, the light that determines correct lens settings is not affected by subject reflectance, and it is quite obvious that this should be the logical and preferred method. Incident metering is unquestionably the easiest method; the one most likely to provide the correct lens settings under most subject and lighting conditions. If you have used this method, or if you have such a meter, by all means use it. Incident metering can eliminate many exposure problems and could therefore be recommended as the one and only metering method. This does not make sense today, however, because most photographers in the future will use meters built into cameras. They provide perfect and accurate exposures in all subject and light conditions if used properly, and have additional advantages.

Use of grey card

As reflected meters are correct when 18% of the light is reflected why not try to measure something that reflects 18% all the time? This is possible by using the grey card available in camera stores. Hold the grey card in front of the subject and take a reflected meter reading from its 18% reflectance instead of a subject of unknown reflectance. The grey card reading should be the same as an incident light reading. Basically the grey card is held in the same place and direction as an incident meter would be, in front of the subject, so that the same light that falls on the subject falls on the grey card. Hold the meter not more than 20 cm (8 in) from the card so it measures only the grey area. Do not allow the shadow of yourself, or your hand and meter, to affect the reading. With a built-in meter, hold the camera in the same way, at the same distance, so that nothing but the grey card is visible in the finder. When using the meter-prism, the distance between grey card and meter should be about 15 cm (6 in) with the standard lens and twice as far with the 150 mm lens.



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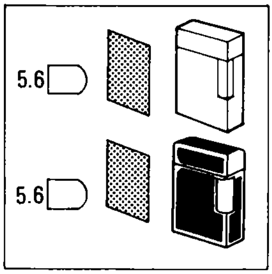

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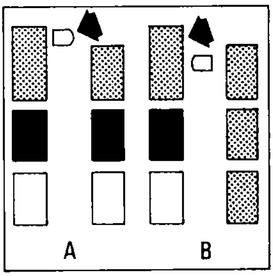
Instead of measuring the light reflected off the subject, you can measure the light reflected off an 18% greycard (**1**). The reading is then the same whether the card is held in front of light or dark subjects (**2**).



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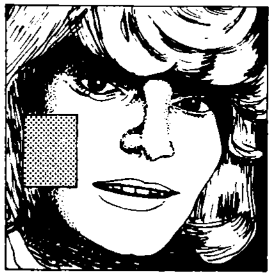

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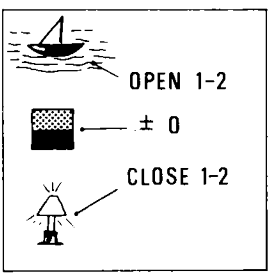
The different results obtained with incident and reflected meters are illustrated in **3**. The subjects (grey, black and white) are on the left in each case. Based on an incident reading (A) the subjects are recorded as they are (grey, black and white). Based on reflected reading (B) all three appear as grey.

4 Close-up readings of skin tones with a reflected meter are not necessarily correct: white skin tones are one stop lighter than greycards; black skin tones one to two stops darker.



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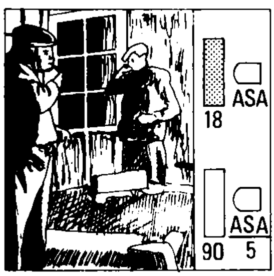

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5 Reflected meter readings are correct only if they are taken from a subject that reflects approximately 18% of the incident light. When brighter subjects are measured, the aperture must be opened one to two *f* stops. When darker subjects are measured, the aperture must be closed one to two *f* stops.

6 You can also read the white side of the greycard and set the meter to $\frac{1}{5}$ the ASA rating of the film.

While the grey card is an additional item to carry, it is highly recommended. It has provided extremely satisfactory results and has solved many exposure problems, which could not have been solved without extensive bracketing.

The grey card as a colour test

The grey card is of known colour and can therefore be photographed together with the subject to check how the light source matches the film. More importantly, a grey card included in one of the images on negative colour film can be valuable, or even necessary, to the laboratory for printing. Without a subject of known colour value in the negative the laboratory is somewhat at a loss to know what the colours in the print should be. In portraits, they usually base it on flesh tones. In images that do not include people the inclusion of a grey card in one of the negatives taken in one location is practically a necessity. It is especially important when pictures are taken under anything but 'standard' lighting, such as fluorescent lights, or on overcast days.

Using the white side of the grey card

The rear side of the grey card is a specific white that reflects 90% of the light. It too can be used for reflected light meter readings.

In low light levels, the light reflected from the grey side may be too weak to give a meter reading, or the reading will be at the extreme low end of the scale. In such situations take the reflected meter reading off the white side which reflects five times as much light. Compensate for the higher reflectance by setting the reflected exposure meter for a film sensitivity five times lower than the film in the camera, for example set at 20 ASA if the camera is loaded with 100 ASA film. Hold the card as described before, and take the reading off the white side. Use the lens settings as shown on the meter. Do not forget to reset the ASA index on the meter when the grey side of the card is used again.

'Palm' readings

The palm of the hand is frequently recommended as a substitute for a grey card. Hold your hand in front of the subject like a grey card and take the meter reading from about 5 cm (2 in) away. The palm of the hand is a good substitute, as its reflectance is practically the same for everybody at all times. The principle is sound, but most palms reflect more than 18%. When taking palm readings, therefore, set the lens one EV value, or one *f* stop, lower (open the lens one stop).

Flesh tone readings

A common method of determining exposure when photographing people is through a close-up reading of the flesh tones. While the flesh tones should be

presented properly, such a reading can be correct only if the skin tone reflects 18%, which a sun-tanned face or body does. It cannot be correct for real white or black skin tones. They need an adjustment as does any other subject. For white skin tones, open the lens one *f* stop, for black skin tones, close the lens one or one and a half *f* stops or EV numbers.

What to expose for

Up to now only how to obtain correct exposure for subjects of different brightness and colours has been discussed. Usually some areas in a picture receive more light than others: some subjects are in bright light, some are in the shade. Which area should be exposed for, the shaded areas, the lighted areas, or somewhere in between? This does not refer to dark and light coloured subjects, but to the amount of light falling on these dark and light subjects. The logical thought might be to set the lens somewhere between the reading of the lighted and shaded areas. If the contrast is not too great, the result is probably acceptable, but never the best. Negatives exposed in this way lack printable shadow details and slides unquestionably have washed out highlights. The method I use and which works beautifully with all subjects, in all lighting situations and photographed on all film materials, is to *base exposure for transparency films on the lighted areas* and those for *colour or black-and-white negative films on the shaded areas where detail is desired.*

The above method determines where and how to hold the exposure meter. For negative material, the incident meter is held in front of the shaded area of the subject with the cell pointing towards the camera. A reflected meter is pointed at the shaded area of the subject or at a grey card held in the shaded area.

For transparency film, an incident meter is held in the lighted part of the subject, a reflected meter is pointed at the lighted area or at a grey card held in the lighted area. Transparencies exposed in this way lack shadow detail, but this is not usually objectionable and always overshadowed by the rich, beautiful colour saturation. Washed out highlights can be very objectionable in slides and movie scenes.

With frontlit subjects, hold the incident meter with the cell pointing towards the camera and a grey card facing the camera. With a sidelit subject, outdoor or in the studio, point the incident meter cell halfway between the main light and the camera, and hold the grey card so that the grey side faces halfway between the main light and the camera.

For photographing documents, simply lay the grey card flat on the artwork or hold the incident meter on top of the copy. The reading is correct whether you photograph black line work on white paper or white copy on black or any other colour cardboard. The same approach, i.e. placing the grey card flat on the ground, is excellent for most scenic outdoor photography, especially when photographing bright areas, water surfaces, snow-covered

fields, or sandy areas, such as deserts or beaches. The benefit of placing the grey card on the ground, is that it makes no difference from which side the sunlight falls, front, side or back—the grey card reading is always the same. The reflected meter reading of the grey card is taken by pointing the meter straight down at the card.

When using the method of shadow reading for negative material and highlight reading for transparency material, it is best to use the ASA rating recommended by the film manufacturers and to develop the black-and-white films according to the manufacturer's instructions.

With reflected light meters, it is important to ascertain that the cell receives light only from the area to be exposed for without being influenced by surrounding dark or light backgrounds. This is of utmost importance with white backgrounds in a studio or white overcast skies outdoors, as even the slightest amount of light from these bright areas can swing the needle two to three EV numbers higher. When subjects are backlit, the meter must be held so that a light, or the sun, does not shine directly into the cell. If necessary, shade the cell from direct light with your hand or another object.

Bracketing

If you use your exposure meter as recommended you should have very satisfactory exposure in all your negatives or slides. Bracketing, which means taking the images at two or more different lens settings, should not be necessary. Not that there is anything wrong with bracketing, but it uses a lot of film, especially if you bracket every shot. It is recommended, however, when slides are made of subjects with extreme contrast. It is not so much for the purpose of good exposure but for producing the most effective image. 'Perfect exposure' in such cases is not necessarily determined by technical considerations but may be a case of personal preference. A darker image may be more effective as it is more dramatic. Early morning shots of scenery or people may be more beautiful when colours are more on the pastel side creating a low-key effect.

Special effects accessories

When accessories are placed in front of the lens or between lens and film, exposure of a separate or built-in meter may have to be adjusted. Accessories made from clear glass or plastic, covering the entire lens or image area do not require a change in exposure regardless of whether the reading is taken from a separate or built-in meter.

Among the non-absorbing devices are close-up (Proxar) lenses, multi-prisms, diffusion filters, star filters and other clear special effects filters, and clear gelatin.

Accessories made from coloured glass or gelatin and covering the entire lens absorb light and need an increase in exposure when a separate meter is

used. Built-in meter readings are correct with most filters as the light is measured through the filter.

There is another group of devices which are placed a few inches in front of the lens and cover only *part* of the image area. This includes all types of vignettes, masks and diffusion devices which soften only part of the image. Exposure is always based on the area seen through the device. The lens settings do not, therefore, need to be changed. These devices, especially black masks and vignettes, block off some of the light that reaches a built-in meter, so the built-in meter reading made through the mask is *incorrect*. The simplest way of obtaining the correct reading is to take the meter reading *without* the mask or vignette and to use this setting for the exposure.

Other uses of meters and grey cards

Exposure meters are ideal for determining ratios between main and fill lights, frontlights and backlights, subject and background, and shaded and lighted areas. They are important or necessary to assure even lighting distribution, especially when photographing interiors or documents. In all these cases use either an incident meter or a reflected meter with grey card. The grey or white side can be used as the two values are only being compared. When photographing documents take readings in the centre and all four corners.

Controlling backgrounds

Measuring the light falling on the background and comparing it with the light falling on the main subject is especially important in colour photography. The background appears on the film in the colour observed visually only if it receives the same amount of light as the main subject which the exposure was made for. All backgrounds only appear in their true colour with this 1:1 lighting ratio. The lighting ratio is checked with an incident meter by holding the meter in front of the main subject and in front of the background behind the subject. With a reflected meter, the reading is made from the grey card held in front of the main subject and the background.

Determining lighting ratios

Decide whether you want to determine the real ratio between main and fill light, or the lighting ratio that the lights produce on the subjects. These are not the same because the fill light usually adds light to the side covered by the main light.

For checking the lighting ratio between main and fill, hold an incident meter in front of subject, pointing directly into the main and the fill light. With a reflected meter take a reading off the grey card held in front of subject facing directly towards the main light, and a similar reading with the card facing

directly towards the fill. To determine the lighting ratio on the subject, proceed as follows: turn main and fill lights on and aim an incident meter from the subject towards the lights so that the maximum meter reading is obtained, or take a reflected meter reading of the grey card turned in front of the subject so that the maximum reading is obtained. Then turn the main light off and take the second reading of the fill light with the incident meter pointing directly into the camera lens, or with a reflected meter off the grey card facing the camera lens. The two readings give the true lighting ratio on the subject. The actual ratio is obtained from the difference between the two measurements in either the EV numbers or the *f* stops. Lighting ratios with multiple electronic flash set-ups are determined in the same way but with a flash meter.

An equal reading in both the above measurements naturally means a 1:1 lighting ratio. A 2:1 ratio exists with a difference of one *f* stop or EV number; 3:1, with a one and a half EV or *f* stop difference; 4:1, with a difference of two; and, 8:1 if the difference is three *f* stops or EV numbers.

Lighting ratios can be determined without an exposure meter from the light-to-subject distance. If two identical lights, as main and fill lights, are placed at equal distances, the lighting ratio is 2:1 (not 1:1 because the main light also lights the area covered by the fill light). For a 3:1 ratio, move the fill light 1.4 × further away, and another 1.4 × further away for a 5:1 ratio.

Subject brightness range

Our eyes are capable of bridging tremendous brightness ranges, allowing us to see details in shadows and highlights beyond those that can be recorded on photographic materials. Films and papers have far greater limitations than the human eye.

The subject brightness range is the range between the different colours in the subject. The range is greatest when the subject has clear whites and black blacks. The subject brightness range is therefore predetermined by the subject and cannot be changed, at least not if the area is evenly lit with one light. It can be changed only by using separate light sources for different areas, e.g. for the light and the dark areas for subject and background.

The subject brightness combined with the lighting ratio is what is recorded on the film and that is known as the *scene brightness range:*

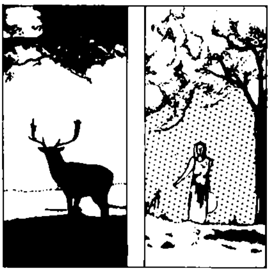
$$\text{scene brightness range} = \text{subject brightness} \times \text{lighting ratio}$$

For example, if the subject brightness is 10:1 and the lighting ratio is 3:1, then the scene brightness range is $10 \times 3 = 30:1$.

The brightness range that can be recorded on colour negative or black-and-white film is about 64:1 which is equivalent to six *f* stops. If details are desired and necessary in the shadows and highlights, the difference in a meter reading between the darkest and the brightest area, therefore, should not exceed the six *f* stops. While this range falls within the capability of the film, it

must be remembered that the paper has greater limitations. Its range is only about 40:1 or five *f* stops. This is also the approximate range for transparency film.

To record the entire brightness range satisfactorily on the film, exposures must be accurate to ensure that they fall within the film's latitude. If the exposure is too long, the whites and light greys start to fall together and the highlight areas lack detail. If exposure is too low, the blacks and dark greys are no longer separated and the shadows lack detail. In black-and-white, contrast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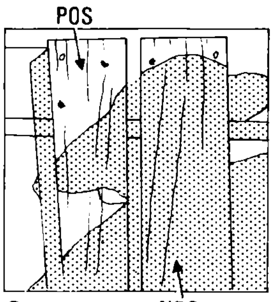

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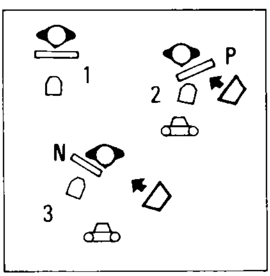
1 When part of the scene is in shade and part in the light, you must decide what area exposure should be based on.
2 Slides (pos) should almost invariably be exposed for the lighted area, colour negative or black-and-white film (neg) for the shaded areas where detail is desired.
3 With transparency materials, the meter reading should be based on lighted areas marked 'P', negative materials on shaded areas marked 'N'.



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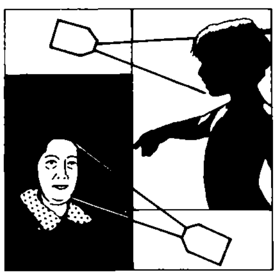
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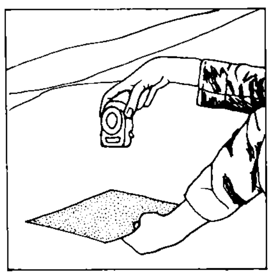
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4 When readings are made off the greycard, the card is held on the lighted side with slide film (2) and on the shaded side when working with negative materials (3). With flat front light, the greycard is held in front of subject facing the camera (1).
5 Reflected light meter readings must be based on the main subject without being affected by light (top) or dark backgrounds (bottom).
6 When photographing scenery, especially snow or sand, the easiest way to get a perfect reflected light reading is by holding the greycard parallel with the ground and pointing the meter straight down at it.

can be controlled with lighting, film developing, different grades of enlarging paper and paper development. In most colour photography, the control is limited to lighting.

Typical subjects and measuring methods

General scenes with blue skies. A reflected meter reading of blue sky, produces good results on slide film. Make certain that the meter reading is not influenced by white clouds. With negative film, measure the shaded area if detail is desired.

Sunsets and sunrises. The sky is usually the most important part of the image. Foregrounds are silhouetted. For slide film, take a reading of sky, making certain that the sun does not shine directly into the meter cell. For negative film, measure areas where you want shadow detail, the ground, or the water surface perhaps.

Backlit scenery. For transparency film, measure the light falling on the lighted area; for negative film, measure the light in the shaded area.

Pictures through windows, archways, etc. The foreground, the arch or window frame, is to be recorded as a silhouette, so exposure is based on the background area. Hold the reflected meter through the arch or window so that it measures only the background. The same method applies whenever a foreground is to be silhouetted.

Backlit portraits. Sunlight is used only as an accent light or a hair light. Exposure, therefore, should be based on the light falling on the face. Take an incident reading with the meter held in front of the face, or a reflected close-up reading of a grey card held in front of the face; or of the face, adjusting for skin tone. This applies to negative and transparency film.

Portraits with window light. Lighting ratio is high with daylight falling on one side of the subject only. Reflectors may have to be considered to lighten the shaded side and bring the contrast range within the capability of the film. For slide film, measure the daylight falling on the lighted side of the face. For negative film, base the lens settings on the shaded side of face, or if the contrast is too high, between the highlight and shadow readings.

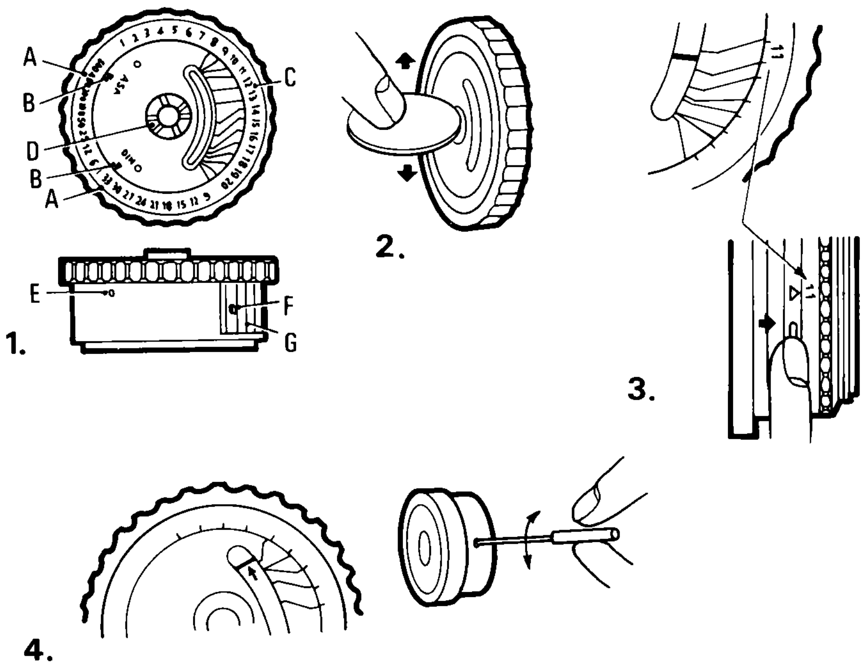
Stage shows. Spotlit performers on the stage are frequently in front of dark, dimly lit backgrounds. Exposure must naturally be based on the lighted performers. If at all possible, take a close-up meter reading. A spot meter has a definite advantage as you can take a reading of the performers from a distance. With built-in meters the reading can be made through a tele lens, which will cover the lighted area only.

Fireworks. Set the shutter on time, or the bulb, and keep the shutter open from the beginning to the end of the rocket display. Suggested apertures for this type of photography are: *f*16 for 400 ASA film; *f*11 for 160 ASA; *f*5.6 for 40 ASA; *f*8 for 64 ASA; and, *f*4 for 25 ASA.

Exposure meter knob

This selenium cell exposure meter, with a measuring angle corresponding to the standard lens, is calibrated for film sensitivities from 6 to 1600 ASA (9-33 DIN). It has an opal diffusion screen which can be moved in front of the cell for incident meter readings.

The exposure meter knob is really nothing more than a hand-held exposure meter, but it has the advantage that it can be attached to the camera so that it is always readily available. It can be attached to the 500C/M in place of the standard winding knob or, if the camera has the rapid winding



The meter knob

1 A: film sensitivity scale; B: index for setting film sensitivity; C: EV scale; D: slotted disc for setting film sensitivity; E: attach/release lock; F: lock for translucent cover; G: sliding translucent cover.

2 Set the knob for film sensitivity by turning the slotted disc with a coin until the white triangular index is opposite the sensitivity of the film in the camera. For incident light readings, slide the cover over the cell; for reflected light readings, move the translucent cover so the cell is exposed. The cover is locked in either position with the catch which must be pushed sideways before the cover can be moved.

3 Whether used as an incident or reflected meter read off the exposure value opposite the channel to which the needle points. Set this value on the lens.

4 To check the meter, shield it from all light by covering the cell with your hand. Check whether the needle points to the small white line at the extreme left of the scale. If not, turn screw E(1) carefully until the needle is opposite the white line.

crank, to one of the square sunshades by means of the exposure meter attachment. Meter readings that are normally made from the camera position can be made with the meter attached to the camera. It can be detached instantly for close-up or incident meter readings.

Attaching and detaching the meter from the camera is done in the same way as for the regular winding knob. The same procedure is also used for attaching or removing it from the meter attachment.

Having a selenium cell, this type of meter needs no battery as the light that strikes the cell produces the necessary current to move the needle. A selenium meter, however, is not as sensitive as the newer CdS or silicon types and its application is therefore limited in low light measurements. Although the meter knob does not look important, it is an accurate, rugged, reliable device. The way you see the needle position depends somewhat on the angle at which you look at the meter knob; to eliminate discrepancies and make the reading accurate, the surface below the needle is a mirror which reflects the needle. The reading should be made so that the actual needle and its reflection are seen on top of each other. Dust and dirt may accumulate around the window. Blow, brush or wipe clean carefully.

The meter prism finder

The meter prism finder is a centre-weighted system, therefore, whatever is in the centre of the area affects the meter reading most. The area you want to base your exposure on should, therefore, cover the centre when the reading is made.

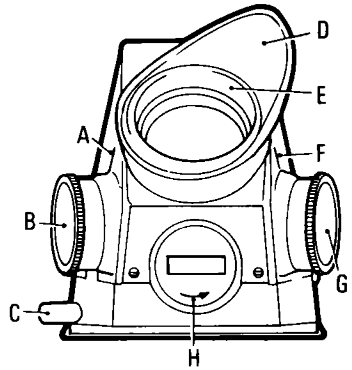
When you want to base your reading on smaller area, either move closer to the subject, with a camera equipped with a meter prism, or equip the camera with a longer focal length lens that covers the smaller area. It becomes then somewhat like a spot meter. Instead of measuring a 52° diagonal field (with an 80 mm lens) you measure an 18° diagonally measured area (with a 250 mm lens). This procedure is valuable for long distance shots when it is not practical or possible to move closer to the subject.

Different film magazines

As the meter prism reading is based mainly on the centre area, it works equally well with all film formats, $2\frac{1}{4}$ in square, $4\frac{1}{2} \times 6$ in and Superslides without the need for adjustment. Use the transparent ground-glass masks only.

Different ground-glass screens

Meter prism readings taken with the various ground-glass screens vary less than half an *f* stop and therefore no adjustment is necessary when changing from one screen to another. If, for one reason or another, a somewhat darker or



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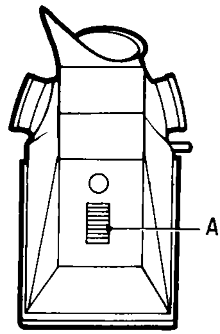
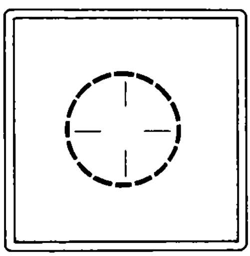


2.

The meter prism finder
1 A: index for film sensitivity; B: film sensitivity dial; C: magazine release button; D: rotatable eyecup; E: position for correction lenses; F: index for lens aperture; G: lens control dial; H: battery compartment cover. **2** A: on/off switch.

To operate the prism finder, set the film sensitivity dial so that the ASA or DIN rating of the film is opposite the index line and the lens control dial to the maximum lens aperture. (The latter setting compensates for the fact that the meter will receive more light through a fast, *f*2.8 lens than a slow, *f*5.6 one.) Turn the meter on and set the EV number indicated in the finder on the lens. When not in use, turn the meter off to conserve the batteries.



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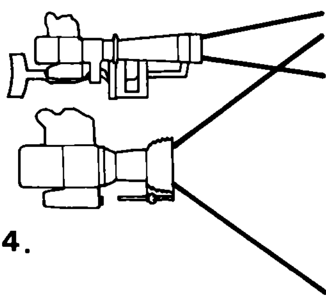

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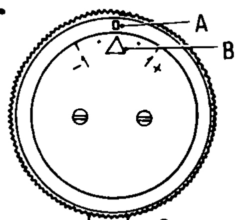


5.

The meter prism finder uses a built-in battery-powered CdS cell to give a centre-weighted reading from approximately 50% of the light within a 26 mm circle, and displays the information clearly in the viewfinder (**3**).

The reading in the viewfinder is based on the area covered by the lens (**4**)—a large area with a wide-angle lens and a smaller one with a telephoto.

To change the setting on the adjustment knob (**5**), depress the lever (C) and rotate the disc until the desired correction setting is opposite index (A). The white triangle (B) is the normal setting. If the adjustment is turned towards '+' the images are given more exposure; turned towards '–', less exposure.

lighter negative or slide is desired, the adjustment can be made on the side knob.

Meter prism on the focusing screen adapter

The meter prism, as with all Hasselblad viewfinders, can also be attached to the ground-glass adapter called the focusing screen adapter. This also allows through-the-lens light measuring on the Superwide C, for which the ground-glass adapter is mainly made.

The EV setting obtained on the ground-glass adapter with the meter set at the maximum $f/3.5$ aperture of the Biogon lens has been found to be correct.

Operation of the meter prism

The film sensitivity is set on the left-hand knob (seen from the viewing position). The right side of the prism has an adjusting knob with aperture engravings, the purpose of which seems to be unclear to many photographers. On the Hasselblad cameras, as on all single-lens reflex cameras, the lenses are normally wide open (unless manually closed down) and the meter reading in the camera is made with the lens at its maximum aperture. The meter, therefore, receives more light when the reading is made through an $f/2.8$ lens than through one with an $f/5.6$ maximum aperture, even though both may be pointed at exactly the same subject. The adjusting knob on the meter serves to correct these differences. The knob, therefore, must always be set at the maximum aperture of the lens on the camera and the setting must be changed when switching from one lens to another with a lower or higher maximum aperture. When adjusted in this fashion, the meter cells receive the same amount of light whichever lens is on the camera.

The meter prism finder to be introduced in 1981 differs from the older type mainly in the type of cell. The 1981 model has a blue-sensitive silicon cell, rather than a CdS. The meter reading is also given in EV values but shown on light-emitting diodes. The range is 2–19 EV for film sensitivities from 25 to 6400 ASA. It is equipped with a PX28 battery and designed to be usable with the Polaroid film magazine.

Battery and battery test

The original meter is powered by a mercury PX 625 cell. You can check whether the battery is in good condition or needs to be replaced, but there is no practical way of checking how much power is left in the battery. It is therefore recommended to replace the battery once a year, whether the meter is used or not, and to carry a spare battery on any important photographic mission, especially if it takes place in an area where batteries are not readily available. To test the battery, turn the meter on and point the meter prism, on or off

the camera, towards a uniform light source. Check the EV reading and depress the battery test button for not more than 1 sec and watch the needle. The battery is in good condition when the needle does *not* move more than 1/3 of an EV value. A greater needle movement indicates that the battery should be replaced. The centre of the aperture adjusting knob has a disc which reduces or increases the meter reading by one half and one full EV value. This adjustment is built into the meter prism so that you can correct for your individual taste in negative or transparency density.

Meter prism with fast lenses

The meter prism, introduced before the availability of the faster lenses for the 2000FC model, can be adjusted only for lenses up to *f*2.8. For correct readings with a faster lens three procedures can be followed:

1. Take the reading with the meter set at *f*2.8, but use a lower EV setting on the lens. For an *f*2 lens, set the EV number on the lens one number lower, e.g. 12 when meter indicates 13.
2. Make an adjustment to the individual correction knob. Set the control to +1 when using the *f*2 lens with the aperture control knob set at *f*2.8.
3. Set the ASA/DIN control knob to a lower rating than the film in the camera. Set it 3 DIN values lower (15 instead of 18) or at half the ASA rating (50 ASA for 100 ASA film) with an *f*2 lens and the aperture control set at *f*2.8.

Erratic meter movement

CdS meter cells, as found in the Hasselblad meter prism, have a memory which may affect the action of the meter for a short time, especially if the meter has been pointed directly into a bright light source. This erratic meter action will stop after a few minutes.

Automatic aperture control

Automatic aperture control can simplify and extend your photographic possibilities.

The diaphragm on the automatic lenses is opened and closed by a servo motor which is a permanent part of the lens. The Planar 80 and 100 mm and the Sonnar 150 and 250 mm lenses can be purchased with the motor attached. If you already own one of these lenses, and it is not too old, the servo motor can be added to it at a Hasselblad service centre.

The servo motor is powered by NiCad batteries, which can be the batteries in the EL/M camera or the smaller battery 2 (DEAC 5/225 DKZ) placed in the battery container and attached to the accessory rail of the 500C/M, 2000FC and 500EL/M camera. The battery is recharged inside the container

using Recharge Unit I or III. Charging time is the same as for the EL/M battery. A fully charged battery should last for about 24 hr on stand-by operation when the lens diaphragm changes only occasionally and for about 2 hr under almost continuous change in aperture.

Meter cell. A blue silicon photocell 'reads' the light as a regular exposure meter does and sends its signal to the motor which then opens or closes the diaphragm until the aperture is correct for the meter reading. The procedure is almost instantaneous as silicon blue cells have a much faster reaction time than CdS cells.

The silicon photocell has very little inertia, which results in an extremely rapid response to variations in light intensity (a sweep from *f*2.8 to *f*22 takes only about 1 sec). The silicon cell also responds with great accuracy even when light levels are very low, and its spectral sensitivity is largely the same as the spectral sensitivity of the human eye and the common film emulsions.

The cell is located above the lens. It does not measure the light through the lens and you must therefore consider extension and filter factors as you do when using a hand-held meter. The acceptance angle of the cell is adjusted so that it measures closely the same area as covered by the lens.

Prior to use, the servo-controlled lens must be set for the sensitivity of the film in the camera and for the desired shutter speed. If the light is insufficient for correct exposure at the set film speed and shutter speed, a red light marked (–) lights up. If the light is so bright that even the smallest aperture on the lens still produces overexposure, the red light marked (+) remains lighted.

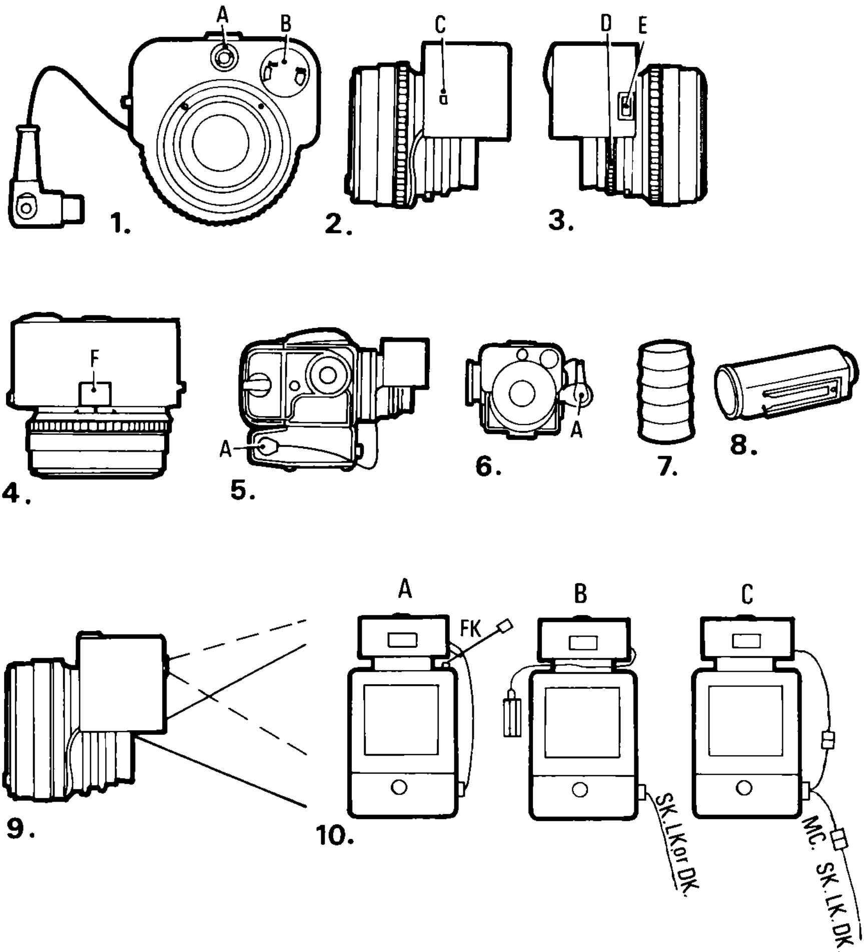
If either one of these lights stays lit, change the shutter speed until the aperture falls within the range of the lens if this is possible. The red indicator lights are on the side of the lenses and are large and bright so that they can be seen from a distance. This is quite valuable as automatic aperture-controlled lenses are frequently used in remote operations.

If automatic operation is not desired, the aperture can be set manually. Turn off the operating switch, and turn the diaphragm ring to the desired aperture. The engravings are at the bottom of the lens, so the camera must be turned upside down.

Automatic exposure

What are the advantages of automatic operation? Firstly, you are constantly ready for shooting. There is no need for meter readings or manual lens adjustments—focusing remains the only thing to do. When multiple cameras are used with automatic lenses, the apertures on all the cameras adjust automatically to the same setting, or to a different but correct setting when cameras are loaded with films of different sensitivities.

Often, when cameras are operated from a distance, in wildlife photography, for instance, you cannot or may not want to go near the camera. Automatic adjustment then becomes a necessity. In time lapse and surveyance



The automatic diaphragm control unit

The automatic diaphragm unit gives continuous speed settings in situations where manual operation is not possible. The light is measured by the silicon cell (**1**A) when the unit is turned on with the switch at the side (**2**C). The angle of view the cell measures is very close to the area covered by the lens (**2**). The film speed is set on the dial at the front of the unit (**1**B) and the exposure time in the window (**4**F). The diaphragm opening can be read on the aperture ring (**3**D). At the side of the unit are two lights (**3**E); the upper one, marked '+', lights up if there is too much light for the lens setting and the lower one, marked '–', if there is too little.

On the 500EL/M, the unit can be powered by the camera batteries by connecting it directly to the rear camera socket (**5**A). On other cameras, a battery container (**8**) containing a rechargeable battery (**7**) can be attached to the accessory rail (**6**A).

10 The 500EL/M with the automatic diaphragm unit can be released from the front with the remote release cable FK when the unit is powered by the camera batteries (A). Alternatively the unit can be powered from the accessory batteries and the camera released through the rear socket with the SK, LK or DK release cables (B). To power the unit from the camera batteries and release through the rear socket use the multiple connector and the SK, LK or DK release cables (C).

applications when the EL/M takes pictures at regular intervals controlled by a timer, the automatic aperture control ensures that exposures are correct even if light levels change.

You must naturally remember that the cell in the automatic lenses measures the light in the same way as any reflected meter. With most subjects and fairly normal lighting conditions, exposures are surprisingly good. Nevertheless, remember all the points already described, about the use of reflected light meters. Where subject reflectance is much higher (snow, fog, sand) or if backgrounds are much lighter, the diaphragm must be opened. Do this by setting the film sensitivity to half the ASA value (to 50 for 100 ASA film) or three DIN numbers lower (to 18 for 21 film) for each *f* stop compensation. Adjustments for filter and extension factors are also made by setting the film speed ratings lower.

When the cell measures subjects that reflect much less than 18% or if backgrounds are dark, compensate with the ASA rating in the same way but to a higher film sensitivity.

Beware of direct light shining on the measuring cell.

The automatic lens can serve just as an exposure meter and eliminates the need of carrying another meter, even if you do not want to use the automatic operation all the time.

11

Exposure Controls

THE AMOUNT OF light that reaches the film, and, therefore, the exposure is determined by the aperture and shutter speed.

The aperture

The aperture ring opens and closes the diaphragm built into each lens. The size of the diaphragm opening is engraved on the lens in *f* stops or numbers. A large opening, letting more light onto the film, is indicated by a small number such as *f*2.8; a small opening letting less light onto the film is a high number such as *f*16. This is because the *f* number is the ratio between the diameter of the entrance pupil and the focal length of the lens.

The 150 mm Sonnar is *f*4 because the entrance pupil is 37.5 mm in diameter ($150 \div 37.5 = 4$). The aperture is engraved on the Hasselblad lenses as a ratio, for example 1:4 means *f*4. A smaller entrance pupil results in a higher fraction (a higher number) when related to the same focal length. In order to let more light onto the film, therefore, set the aperture to a smaller number; to cut down the light, use a higher number.

Aperture numbers are multiples of 1.41, for example: $f4 = f2.8 \times 1.41$, $f16 = f11 \times 1.41$. Why 1.41? Because 1.41 is the square root of 2, and light intensity increases or decreases in the proportion of the square root of 2. If you want twice as much light from a light source, move it 1.41 × (not 2 ×) closer to the subject. If you want half the amount of light on the film, decrease the distance 1.41 ×. The *f* numbers work the same way.

A change in aperture from one figure to the next either doubles or halves the amount of light reaching the film. It doubles when moving to the next lower number (from *f*5.6 to *f*4). It is reduced to half when going to the next higher number (to *f*16 from *f*11).

The maximum aperture of a lens is frequently referred to as the speed of the lens and large aperture lenses are known as fast lenses.

Shutter speed

Shutters can be part of the camera body (focal-plane type) or built into the lens (leaf shutter). In either case, the shutter controls the length of time the light coming through the lens shines on the film. Aperture and shutter speed together therefore determine the total amount of light that goes onto the film. The same amount of light can reach the film with many different combinations of aperture and shutter speed. As aperture numbers double or halve the amount of light, it is very easy to compensate for these changes by adjusting the shutter speed.

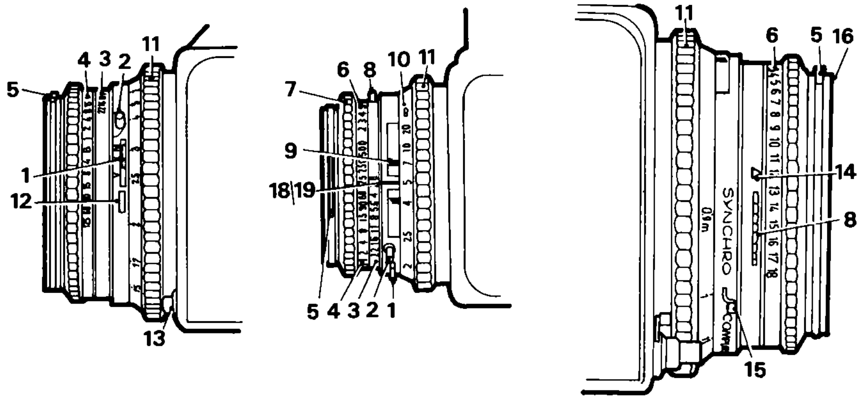
If the aperture is closed one number (from *f*4 to *f*5.6 for example), only half the amount of light goes through the opening. If this amount of light goes through the opening for twice as long, i.e. the shutter speed is doubled from 1/250 sec to 1/125 sec, the exposure is the same. If the aperture is opened one number (from *f*16 to *f*11) the shutter speed must be halved (to 1/30 sec from 1/15 sec).

Exposure value scale

The lens settings that provide correct exposure at various light levels can be determined from charts, from experience or, best of all, from the reading on an exposure meter. On most hand-held meters, you can read aperture and shutter speed or the exposure value. The Hasselblad meter prism and meter knob read exposure values (EV) only. The exposure value is a single figure which represents all the combinations of lens aperture and shutter speed that give correct exposure on a film of a particular sensitivity in lighting of a particular intensity. It is sometimes confused with the light value which is an actual measure of the light level (just like foot candles). In fact, the exposure values (EV) for 100 ASA, 21 DIN film are the same as the light values (LV). The EV reading at a given light level, therefore, depends on the sensitivity of the film in the camera, because the meter has been set for the film speed prior to taking the meter reading. If the EV is 12 for 100 ASA film, it will be 14 for 400 ASA.

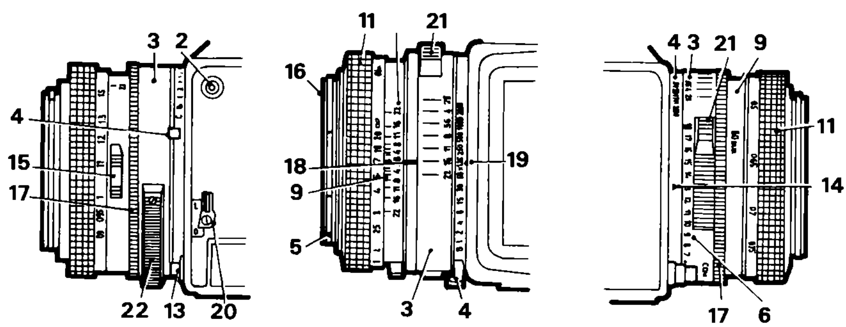
The exposure value system has the great advantage of simplicity; it is easy to remember a single number, and to transfer that from one lens to another. It is also a simple way to remember the exposures to use with particular films in standard lighting conditions.

The greatest benefits of EV, however, are derived from the coupling of aperture and shutter speed of all Hasselblad Compur shutter lenses. On the 2000FC the two can also be coupled when desired. Instead of setting the lens for a specific aperture and shutter speed, you set it for EV. This is done by setting the EV number from the meter opposite the red triangular index on the right side (as seen from the rear) of the lens. The lens is now set for the correct exposure and any of the aperture and shutter speed combination of the coupled rings will give correct exposure. As long as aperture and shutter speed



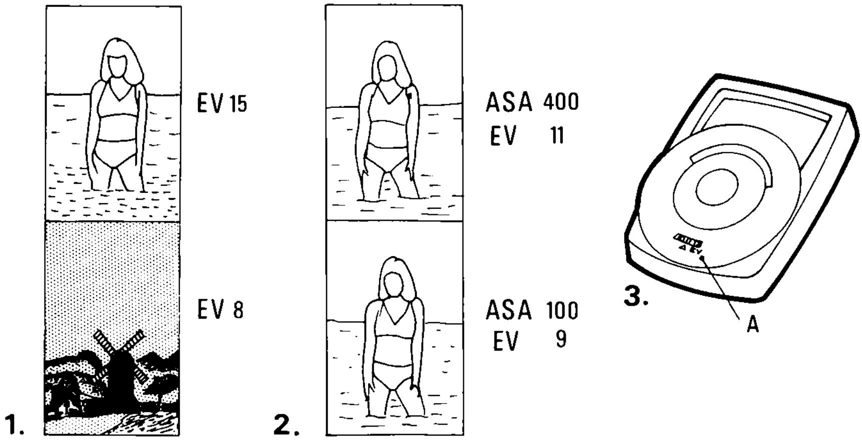
Lens controls—Compur shutter lenses

1. Synchronizing lever. **2.** Flash outlet. **3.** Aperture scale. **4.** Shutter speed scale. **5.** Bayonet mount for lens shade. **6.** Exposure value scale. **7.** Shutter speed ring. **8.** Finger hold for setting exposure values and separate setting of aperture and shutter speed. **9.** Depth-of-field indicator. **10.** Distance scale. **11.** Focusing mount. **12.** Lock for sync lever. **13.** Lock for bayonet lens mount. **14.** Index for EV scale. **15.** Manual stop-down control. **16.** Bayonet mount for filters (inside of mount). **17.** Grip ring for attaching and removing lenses. **18.** Index for aperture. **19.** Index for shutter speed. **20.** Shutter speed ring lock. **21.** Button for cross coupling of aperture and shutter speed. **22.** Grip for aperture setting.

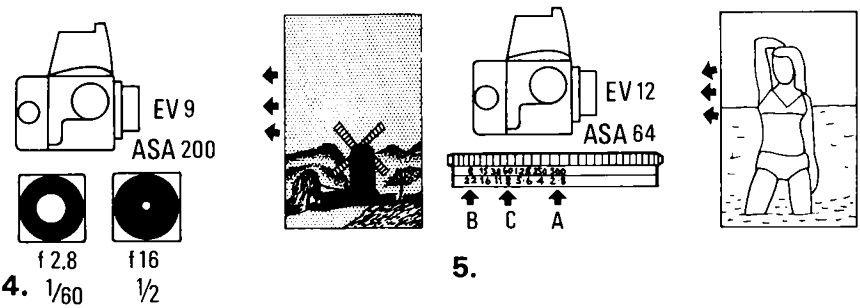


Lens controls—F lenses

1. Synchronizing lever. **2.** Flash outlet. **3.** Aperture scale. **4.** Shutter speed scale. **5.** Bayonet mount for lens shade. **6.** Exposure value scale. **7.** Shutter speed ring. **8.** Finger hold for setting exposure values and separate setting of aperture and shutter speed. **9.** Depth-of-field indicator. **10.** Distance scale. **11.** Focusing mount. **12.** Lock for sync lever. **13.** Lock for bayonet lens mount. **14.** Index for EV scale. **15.** Manual stop down control. **16.** Bayonet mount for filters (inside of mount). **17.** Grip ring for attaching and removing lenses. **18.** Index for aperture. **19.** Index for shutter speed. **20.** Shutter speed ring lock. **21.** Button for cross-coupling of aperture and shutter speed. **22.** Grip for aperture setting.



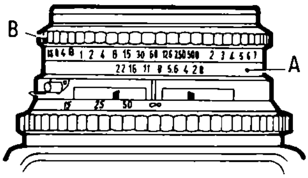
Exposure values (EV) are an indication of the amount of available light.
1 A low EV number indicates a small amount of light; a high number indicates a greater amount.
2 Exposure values are also related to the speed of the film in the camera. For example, using 400 ASA film the exposure value may be 11 while under the same lighting conditions using 100 ASA film the value would be 9.
3 Most professional hand-held exposure meters have an EV scale in addition to the normal aperture and shutter speed indications.



4 Once the exposure value has been determined, you have a choice of several aperture and shutter speed combinations which will give the correct exposure, for example *f*2.8 and $\frac{1}{60}$ sec or *f*16 and $\frac{1}{2}$ sec.
5 When the EV is set on the lens, all positions of the cross-coupled rings give the correct exposure. Changing from a fast shutter speed and large aperture to a slow shutter speed and small aperture, vice versa or to some position in between are easy and quick operations.

ring are left coupled, they can be moved in any way you want and always produce the same exposure.

Once set for EV you can see all the possible aperture and shutter speed combinations. If you want to change one, the other automatically compensates. If the lens is set to 1/500 at *f*2.8 and you want *f*8, simply turn the aperture ring four notches and the speed is automatically set to 1/60 sec. You can take two or more images with different depth of field, or with different shutter speeds, almost instantly and be assured that they will all be equally exposed.



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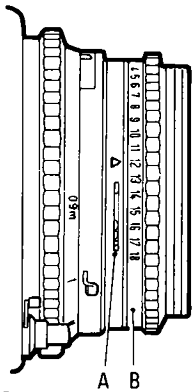
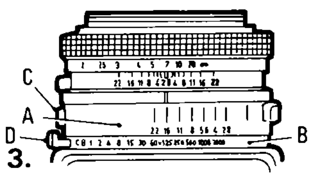


2.

On C lenses, the aperture ring (1A) and shutter speed ring (1B) are cross-coupled. Turning shutter speed ring changes both aperture and shutter speed. They are uncoupled by pressing the cross-coupling lever (2A) towards the camera. Both rings can then be rotated separately. The cross-coupling lever must also be pressed towards camera to the EV scale ring (2B).



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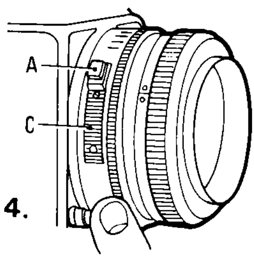
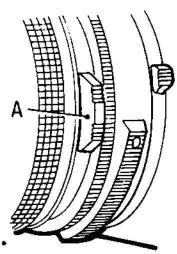


4.

On F lenses shutter speeds are set by turning the shutter speed ring with the thumb lever (3D). Apertures and EV are set by turning the aperture ring (3A) by the grip sections (3C). Aperture and shutter speed ring can be coupled by turning the aperture ring (4C) while depressing the cross-coupling lever (4A).



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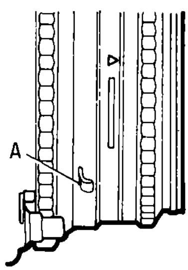


6.

The aperture on all F and C lenses is always wide open unless manually closed down with the stop down lever which is on the right-hand side of C lenses (5A) and the left-hand side of F lenses (6A). Manual stopping down enables you to see what the subject will look like at the aperture that will be used when the camera is released.

Aperture and shutter speed can be changed blindfolded by counting clicks; there is no need to move the eye from the viewfinder. Exposure values are also useful because they separate concern for exposure and creative use of shutter speeds and apertures. Once you have set the EV, you do not have to consider exposure again. Now, your only concern is how to use shutter speed and aperture to create an image.

There is one combination where EV and the aperture and shutter speed interlocking does not work as explained. That is when Compur shutter lenses are used on the 2000FC and the focal-plane shutter is used for shutter control. If you are working with a meter calibrated only in exposure values, you can set the EV on the Compur lens to translate it into shutter speed and aperture combinations. Then set the focal-plane shutter and lens aperture to one of the combinations.

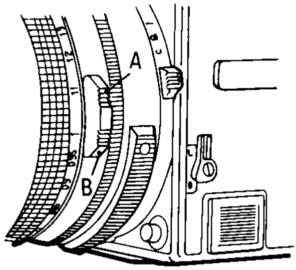
CONVERSION FROM EV TO SHUTTER SPEED/ DIAPHRAGM COMBINATIONS

EV Setting	Equivalent diaphragm and shutter speed combinations (in seconds)								
	*f*2	*f*2.8	*f*3.5 & *f*4	*f*5.6	*f*8	*f*11	*f*16	*f*22	*f*32
2	1	2	4	8	15	30	60	125	250
3	1/2	1	2	4	8	15	30	60	125
4	1/4	1/2	1	2	4	8	15	30	60
5	1/8	1/4	1/2	1	2	4	8	15	30
6	1/15	1/8	1/4	1/2	1	2	4	8	15
7	1/30	1/15	1/8	1/4	1/2	1	2	4	8
8	1/60	1/30	1/15	1/8	1/4	1/2	1	2	4
9	1/125	1/60	1/30	1/15	1/8	1/4	1/2	1	2
10	1/250	1/125	1/60	1/30	1/15	1/8	1/4	1/2	1
11	1/500	1/250	1/125	1/60	1/30	1/15	1/8	1/4	1/2
12	1/1000	1/500	1/250	1/125	1/60	1/30	1/15	1/8	1/4
13	1/2000	1/1000	1/500	1/250	1/125	1/60	1/30	1/15	1/8
14		1/2000	1/1000	1/500	1/250	1/125	1/60	1/30	1/15
15			1/2000	1/1000	1/500	1/250	1/125	1/60	1/30
16				1/2000	1/1000	1/500	1/250	1/125	1/60
17					1/2000	1/1000	1/500	1/250	1/125
18						1/2000	1/1000	1/500	1/250

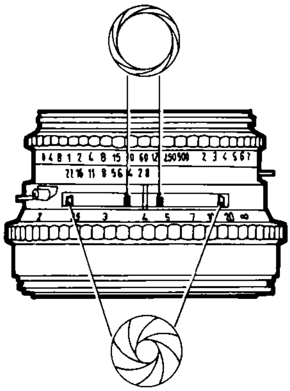
Aperture for depth of field

When the camera lens is focused on a specific subject, 3 m (10 ft) from the camera for instance, only the subject at that distance is theoretically recorded sharp on the film. Sharpness gradually falls off in front of and beyond the set distance. On the photographic print or transparency, however, some degree of 'unsharpness' is acceptable as it still appears sharp. This range of acceptable sharpness is called *depth of field.*

The amount that looks sharp depends on the degree of enlargement from the negative or transparency, and on the standard of sharpness chosen.

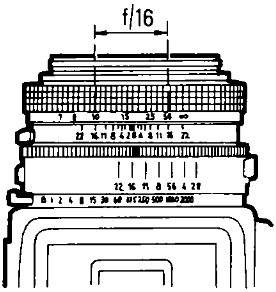


1.



2.

1 F-lenses are manually stopped down by pushing the stop down lever down (A). They are opened by depressing the bottom part of the lever (B).
2 On shutter lenses, depth of field is indicated by the two red pointers which move as the aperture ring is rotated. Depth of field increases when the diaphragm is closed down.



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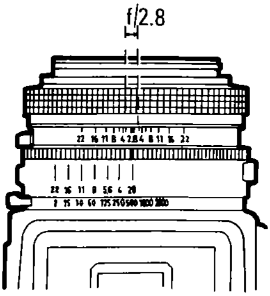

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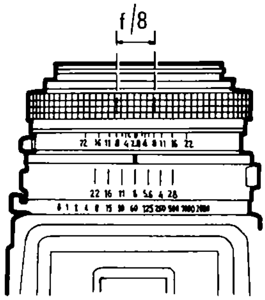


5.

3, 4 and **5** F-lenses have engraved depth-of-field scales. Depth of field is read off the focusing scale opposite the engraved numbers corresponding to the aperture set on the lens.

Hasselblad assume that negatives and slides are blown up to rather large sizes and that Hasselblad photographers are critical of sharpness. Their depth of field scales are, therefore, based on a higher standard than many others. For very critical work or when negatives are enlarged beyond normal sizes, you may want to consider a somewhat smaller depth of field range; for less critical work, when enlargements do not go beyond 8 × 10 in (20.3 × 25.3 cm), a somewhat larger range can be considered acceptable.

At normal distances, the unsharpness increases more rapidly in front of the subject and more gradually behind it. As a result, about 33% of the total depth of field is in front, 67% behind. This can be seen clearly on the engraved

depth of field scales. If you set the 80 mm Planar at 15 ft (4.5 m), the left depth of field marker is opposite 10 ft (3 m) so the depth of field in front of the subject is 5 ft (1.5 m). The right marker is opposite 25 ft (7.5 m) so the depth of field behind is 10 ft (3 m). Since depth of field plays such an important role in photography, all Hasselblad fixed focal length lenses have depth of field scales on the lenses where they are always readily available when needed. The 2000FC lenses have engraved scales, the Compur shutter types have two automatic red indicators that move as the aperture is changed.

The ground-glass viewing screen gives some indication of the depth of field, but cannot show it accurately for a number of reasons. Firstly, with the lens stopped down to *f*11, *f*16 or *f*22, the image on any single-lens reflex camera is so dark you can hardly see the subject, certainly not depth of field. A second reason is the low magnification at which the image is viewed. The ground-glass image is never magnified more than four times. It is impossible to see at four times something that is based on a magnification of at least eight times, especially with the grain of the ground glass suppressing fine image detail. The most important reason, though, is that depth of field is a very gradual fall off in sharpness not a complete change from sharp to unsharp at the depth of field limits.

The ground glass of the Hasselblad is excellent to see what is really sharp, what is completely blurred, and how much it is blurred. In short, it is excellent for evaluating the effectiveness of an image to see what aperture produces the desired results, but not for determining exact depth of field. Use the scales on the lenses for that purpose.

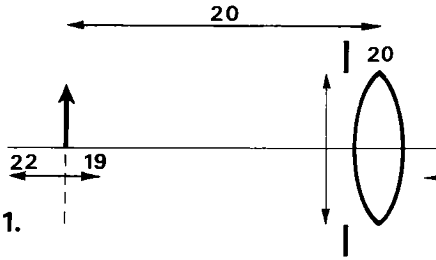
Setting for depth of field

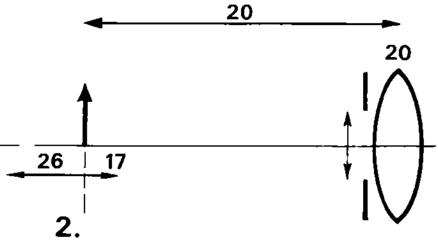
When depth of field is unimportant, simply focus on your main subject—the eyes in a portrait, for example. When, on the other hand, you need a particular range of sharpness, you have to manipulate the focus and aperture settings. Alter these settings until the range of distances you need falls within the red pointers on a Compur lens or between the engraved aperture marks on a shutterless lens.

If the range of distances is beyond the two red indicators even at the smallest aperture or at a usable aperture/shutter speed combination (for instance at a shutter speed short enough for hand-held work) you have to compromise. Decide whether it is more important to have the background or the foreground sharp, or whether it is better to have both beyond the depth of field range.

Hyperfocal distance

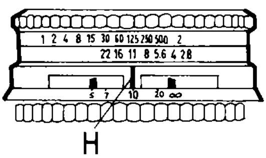
Outdoors, if you want the distant hills or mountains in sharp focus, simply set the distance ring so that the infinity mark is opposite the depth of field indi-

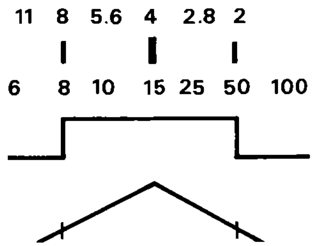




With the lens focused on the subject at 20 ft (or metres) and the aperture wide open, the depth of field may extend from 19 to 22 with one third in front and two thirds behind the focused distance (1). With the lens closed down, the depth of field increases, for instance from 17 to 26, but there is still one third in front and two thirds behind the focused distance (2).

3.



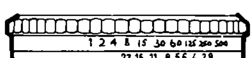


4.

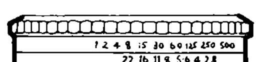
3 With the depth of field indicator set to infinity, the hyperfocal distance (H) is opposite the index. With a lens set to the hyperfocal distance, depth of field always extends from half the hyperfocal distance to infinity.

4 Depth of field is not a range of absolute sharpness (in the example from 8 to 50) with an abrupt fall off to unsharpness but a gradual decrease in sharpness in front and behind the set distance (15). This is the reason why it is difficult, if not impossible, to see depth of field on the ground glass.

5.



6.



With aperture and shutter speed cross-coupled, all positions of the coupled scales give the same exposure, for example *f*2.8 and $\frac{1}{500}$ sec, *f*22 and $\frac{1}{8}$ sec or anything between.

cator on the right. The lens is then set for what is known as the hyperfocal distance. (It is, in fact, also the near limit of depth of field when the lens is set at infinity.) With the focusing ring set at the hyperfocal distance, the depth of field is at its maximum. It extends from the far distance to half the hyperfocal distance. For example, the 80 mm lens at *f*22 has a hyperfocal distance of 16 ft and the nearest point of sharp focus is then 8 ft.

Manual diaphragm stop down

On single-lens reflex cameras the diaphragm is normally wide open to provide the brightest viewing image. The image on the ground glass is, therefore, the image as it appears on film if taken with the lens at the maximum aperture. The manual diaphragm stop down on all Hasselblad lenses allows you to see the effect of closing down the aperture.

On lenses with Compur shutters, the stop down lever is on the right side of the lens between the engraved words 'Synchro' and 'Compur'. The diaphragm is stopped down by pushing the lever forward. Once depressed, the diaphragm opens and closes as the aperture ring is turned again. To return the diaphragm to automatic operation, turn the ring to full aperture (*f*2.8 on the 80 mm Planar). To do this, you may need to uncouple the shutter and aperture rings. In any case, the diaphragm returns to its normal (full-aperture) viewing position when you wind on the camera after taking a picture.

On non-shutter lenses the stop down lever is located on the left side of each lens on the ring with the depth of field engraved. The diaphragm is closed down by pressing the lever downward, and can be reopened at any time by depressing the bottom portion of the bar. The diaphragm does not reset when the aperture ring is turned to the maximum. Neither does it reopen automatically when the winding crank on the 2000FC camera is turned.

The stop down lever is probably one control most photographers should use more often. Too often the image is focused and viewed with the lens wide open, allowing the camera to close the aperture down and snap the picture while the photographer has absolutely no idea what the image will look like on the film. When you operate the stop down mechanism, the lens closes down to the aperture preset on the ring. The ground-glass image becomes darker, the grain on the glass somewhat more pronounced, but you can see the image as it will be recorded on the film. Once the stop down lever has been depressed, the diaphragm moves as the aperture ring is turned. So, you can see how the image changes as the diaphragm opens and closes. You can take the picture with the lever in the stop down position if you wish to.

Background sharpness

The lens aperture also determines the degree of unsharpness of subjects in front and beyond the depth of field. It dictates how sharp or how blurred the

background appears in the photograph. Since backgrounds form a large portion of many images, this is an important consideration. Therefore, do not set apertures just for depth of field. Evaluate the image on the ground glass at different apertures and check the degree of sharpness or unsharpness in the background.

Creative use of lens aperture

Now comes your most important decision: how much depth do you want or need in a picture? That is where technical thinking must end and creative ideas must enter the photographic approach. Before you snap the shutter, you must decide whether everything from foreground to background should be sharp, or whether one or both should be blurred.

With our eyes everything usually appears sharp. They focus practically instantly when looking from one subject to another. There are good reasons why images should be sharp from foreground to background. Many subjects look best, or most satisfactory, only when sharp from front to back. Keep in mind however that such images are the most ordinary ones because they represent the world as we see it. The lens aperture gives us one of the most powerful means to make images different by concentrating sharpness on one narrow plane with the rest of the image blurred. That is often the main attraction of the image on the camera's screen. So, think before you lose the effect by stopping the lens down to make everything sharp.

Selection of shutter speed

The shutter speed may be predetermined from the point of view of exposure, or to allow hand-held camera operation. The speeds you can choose with reasonable assurance of sharpness in hand-held photography depend on the focal length of the lens and your capability to hold the camera steady. A fairly safe rule is to use a shutter speed fraction not longer than the focal length of the lens. A 60 mm lens is satisfactory at 1/60 sec or shorter; a 250 mm lens is preferably used only at speeds of 1/250 sec or shorter. Holding the camera as recommended, you may very well be able to go to speeds twice as long.

When photographing stationary subjects, shutter speeds can be decided on the above considerations alone. This is not so when photographing moving subjects. The shutter speed should then be chosen from the image-creating point of view. It determines how the subject is recorded on the film. You must decide whether the motion is to be frozen, recorded with a little blur, or completely blurred.

Freezing action

A moving subject recorded with a high shutter speed appears to be standing still; this produces interesting and sometimes curious pictures. The shutter

speed necessary to stop action depends naturally on the speed of the moving subject, but also on the magnification of the subject as recorded on the film. If a particular subject fills the entire frame, its image moves further across the film in a given time than it does when it only fills half the frame.

The movement also depends on the angle at which the object is photographed. The image moves the greatest distance when the subject is recorded from the side moving across the picture. It moves relatively little when recorded from the front, moving towards or away from the camera. Between these limits, the movement varies. A change in camera angle to 45° or to straight on can therefore 'stop' action in a way that would not be possible from the side.

Another way to 'stop' motion is to photograph at the peak of the action. It works beautifully with all sports or actions that are not continuous but have a beginning and end or are repeated. In golf or tennis, shoot at the end of the stroke; with people on a swing, shoot at the maximum height as they change direction. There is a peak of action on many rides in amusement parks, in jumping on a trampoline, in ballet dancing and other stage and circus performances. If such actions are caught at the peak, a shutter speed of 1/500 sec is more than good enough with most lenses. To stop continuous motions, such as skiers, motorcycles, cars, horse races, divers, rollercoasters, 1/2000 sec is frequently necessary, especially with long focal length lenses.

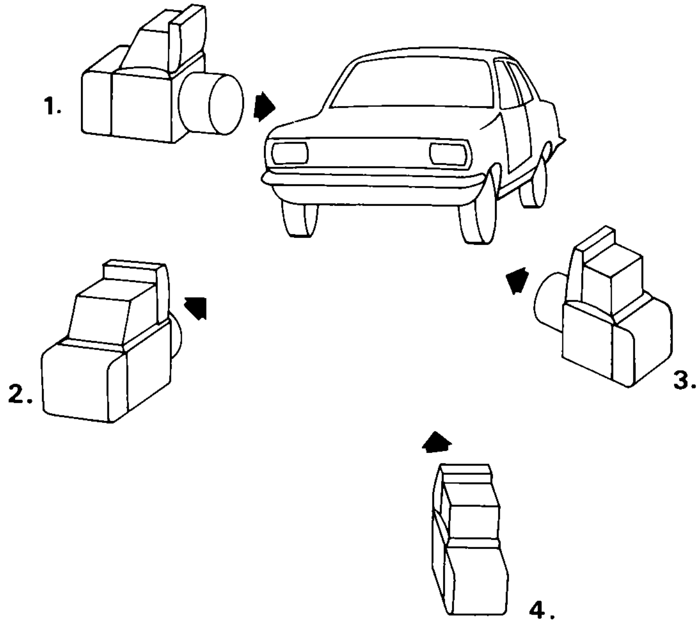
Following moving subjects

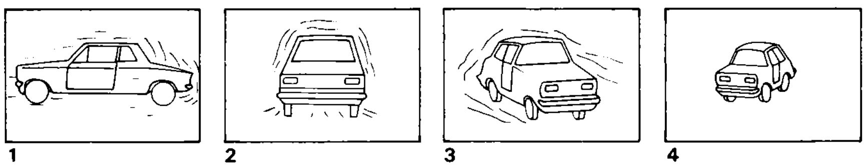
You can use another approach to stop moving subjects by following the subject with the camera and snapping the shutter while the camera moves. This approach is good, not only for stopping motion, but also just for the purpose of being different. If you move the camera at the same speed as the subject, only the background is blurred.

The amount of blurr depends on the shutter speed and focal length of the lens. You can also move the camera slower or faster than the subject, creating a blur in the background and in the subject. With many subjects, some elements are moving in different directions, at different speeds—for instance, the spokes of a wheel, the legs of a bicycle rider or horse, the wings of a bird, the arms of a ballet dancer or ice skater. So, even if the camera is moved at the same speed as the subject, these elements may then also be blurred in addition to the background which enhances the impression of motion even more. If several subjects move at different speeds, there is still more choice of creativity. For example, with two or three runners or bicycle riders, each could travel at a different rate and the camera speed be adjusted so that one is recorded sharp and the others blurred.

As the desired effect on film is frequently based on personal taste, it is difficult to give recommended shutter speeds. For a bicycle rider or runner, start around 1/8 sec. If Polaroid film is available, use it to make a test shot.

Choice of background is important. With a completely plain background,

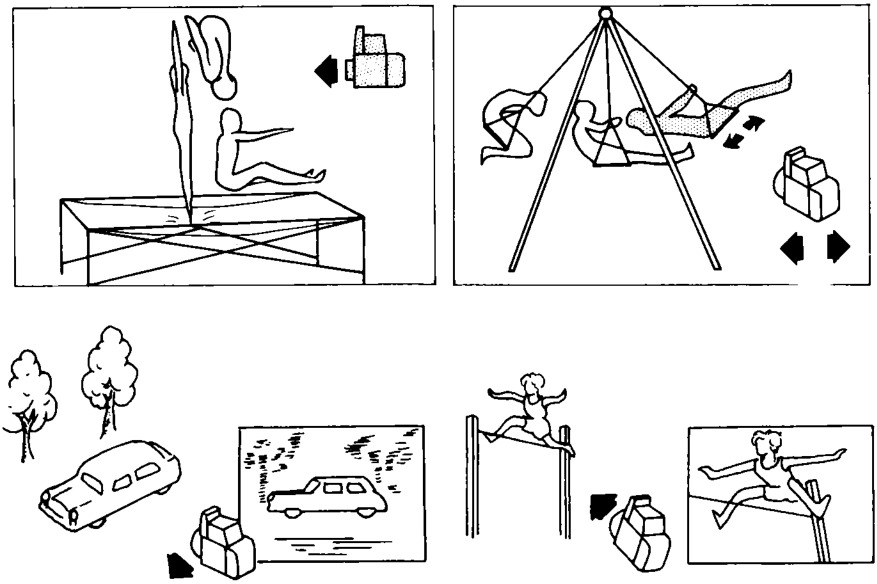




The amount of blur recorded when a moving subject is photographed depends on the position from which the photograph is taken and the size and distance of the subject. Using the same shutter speed, blur is greatest when the subject is moving at right angles to the camera view (**1**). A subject moving at the same speed straight towards (**2**) or at an angle to the camera view (**3**) is less blurred. Viewed from a greater distance, i.e. when the image area of the subject on the film is smaller, there will be less blur, even at the same shutter speed.

such as a blue sky, a plain-coloured wall, or a dark theatre set, camera movement is not noticeable. To bring out the feeling of motion, the streaking effect must be obvious. Highlights and bright areas create the most noticeable streaks, so select a contrasting background such as trees against the sky, sunlight on water, crowds of spectators, etc.

Cameras can be moved hand-held or on a tripod. Many photographers find it easier to follow with a hand-held camera, especially when the subject changes speed or direction as birds or ice hockey players might. If the subject, on the other hand, moves along a straight line, for example a racing car, an



One method to reduce blur when photographing moving subjects is to release the shutter when the subject is momentarily still, for example at the end of a swing or at the top of the bounce from a trampoline. Another method is to follow in the viewfinder the movement of the subject; when the exposure is made the subject appears clear against a blurred background.

athlete in a 100 m sprint, a bicycle rider on a straight road, or an object falling to the ground, a tripod-mounted camera is more likely to produce a successful result. The gunstock is an excellent accessory for a moving Hasselblad equipped with 500 mm TeleTessar.

Looking straight down on the ground glass with the regular finder or magnifying hood can hardly be recommended mainly because left and right are reversed. All prism viewfinders reverse the image. Many photographers find sports and frame viewfinders the best choice. The simple mechanical frame or mask makes it easy to follow the subject and keep it in the centre of the frame. You view the actual subject, not an image, and, therefore, you see everything as bright as it actually is. An even more valuable feature of frame and sports finders is that they show the surrounding area and you can see where the subject might be going and where the camera is moving to.

Blurred motion effects

The feeling of motion can be visually conveyed in a still photograph by recording any moving subject partially or completely blurred. These subjects can include reflections, clouds, smoke, wind-blown trees, flowers, grass, rain, as well as more common subjects such as rides in amusement parks, racing cars and football games.

Shutter speed is one of the greatest creative tools available in photography. It is a tool that allows you to record on film any moving element in an unusual way. The eye cannot 'stop' fast moving action nor can it blur movement, which is why blurred motion effects are fascinating and attract attention—they have impact. Instead of always trying to capture everything sharply, why not make a second exposure at a shutter speed slow enough to blur the motion?

It is not easy to be certain how blurred the image will be; it cannot be seen directly or through the camera's finder. Evaluating the image on the ground glass can help, or watch how far the subject moves within a certain length of time. Even these aids, however, cannot indicate the effectiveness of the image. Whenever you can, try to photograph the subject not only at the speed you calculate, but at two slower and two faster shutter speeds. Keep a record of the shutter speeds for future reference.

Even better, make a test first on instant film material. Slow shutter speeds are one of the most valuable applications of instant film. Within a minute you can see what the image looks like and make the necessary adjustments in the shutter speed, while the camera is still set up.

12

Double and Multiple Exposures

COMBINING TWO, THREE or more images on the same negative or transparency creates unusual images which are likely to attract attention, as they create a sense of unreality.

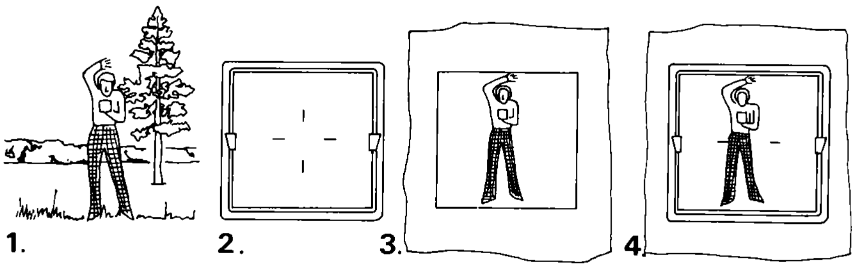
It requires some artistic sense to decide which images go together, how the lines, shapes, colours of the two images will combine together and how two or more images can be arranged so that the combination is more effective and beautiful than each individual image. The two or more images need not be exposed on top of each other, they can be composed so that they fall next to each other, or the second image can be arranged so that it falls into an unexposed area of the first.

Superimposed subjects

Frequently the best effects are obtained if only one image has a well defined subject while the other is a pattern of colours and/or shapes and acts as a background for the first. Beautiful images have been created with brick walls, clouds, reflections, flowers, burlap or paintings as backgrounds. There is no rule that both images must be in sharp focus. Extremely interesting and unusual possibilities are obtained when one of the images is out of focus; it adds a touch of colour, rather than a pattern, to the image.

Two images exposed on the same area of the film result in overexposure if normal lens settings are used. Exposure must be decreased, to an aperture one and a half stops smaller than indicated on the meter for each image. Take a meter reading for each subject in the normal fashion. Set the lens one and a half EV numbers or apertures higher for both images. For example, if the meter reads EV 14 or *f*8, set the lens at EV 15½ or between *f*11 and *f*16. With this equal adjustment in the lens setting, each of the two images should be visible to the same degree, which may or may not be the most desirable effect.

One of the two images can be made more or less visible compared to the



When accurate positioning of images in double exposures is necessary, put a piece of tracing paper over the ground glass and trace the outline of the important subjects. The tracing paper is then used as a guide when framing the second subject.

other by changing exposure, underexposing one more than the other. The combinations that I have found to work well are:

Image I	*Image II*	*Effect*
½ stop under	2½ stops under	Image II hardly visible
1 stop under	2 stops under	Image II less pronounced
1½ stops under	1½ stops under	Both equal
2 stops under	1 stop under	Image I less pronounced
2½ stops under	½ stop under	Image I hardly visible

These figures are easy to remember as they always add up to 3 ($1\frac{1}{2}+1\frac{1}{2}$; $1+2$; $\frac{1}{2}+2\frac{1}{2}$).

Three images superimposed over each other are seldom effective as they are usually confusing, but if you want to try it, underexpose each by two *f* stops.

The image resulting from double or multiple exposures made in the camera can be seen only when recorded on film—not by looking through the viewfinder. Test exposures are therefore recommended if possible. Instant film material is most helpful, as the result can be seen while the camera is still set up, but it is not a reliable guide for exposure in this case. Polaroid colour film has a lower exposure latitude than the regular colour negative or transparency emulsions. A one and a half or two lower EV number or aperture results in a completely underexposed Polacolor image. Therefore, rather than underexposing one and a half stops, underexpose each image not more than one stop on Polacolor film. To say it in a different way, if a one stop or one EV number underexposure looks good on Polacolor, underexpose one and a half stops on the other emulsions.

Ghost images

A figure appears as a ghost when the background is visible through the figure. To do this photograph the same area twice, once with the figure, once without. It can be successful only if the camera remains absolutely stationary.

Superimposed titles

Superimposing the title over a background scene is a common method of producing titles in films. The same method can be used for slide titles. It is nothing more than a camera-produced double exposure of title and background. The background subject is exposed normally—as it would be without the title. The white titling letters must be photographed against a totally black background, so dark that it does not record on the film. Ordinary black construction paper or matt boards are not really black, just a very dark grey. Satisfactory materials are black velvet or TV board available in some art supply stores.

Correct exposure for the white letters is best determined by an incident meter, held above the letters with the cell pointing towards the camera, or a reflected light meter reading off a grey card placed over the letters. White letters are best as they stand out against any dark background colour and they can also be 'burnt in' without looking washed out.

Multiple images

Multiple images are double or multiple exposures where the images are not superimposed. For example, several firework displays recorded in different areas of the film, the sequence of a solar eclipse recorded with six or more images of the sun side by side, or the faces of the family recorded in different masked-out areas.

In these cases, all or most of the second image or images fall onto a dark, unexposed area of the film, and exposure, therefore, need not be adjusted. Use the lens setting as for a normal image.

The success of such multiple images depends mainly on the proper and effective placement of the images within the film area. Some multiple image exposures require masking, for example, head and shoulder portraits of the family or different flowers or foods, combined in one image. Each image is photographed through a mask of the desired shape placed a few inches in front of the lens. The mask keeps the rest of the film area unexposed. The masks can be of any shape, round, oval, triangular, heart shape, etc. The Hasselblad professional lens shade is an excellent accessory to hold the mask. Exposure for the masked-down subject is the same as it would be without the mask.

Split-screen effects

Split-screen effects are multiple images not separated by dark areas but recorded next to each other preferably without a dark or white dividing line. The split can be in any direction; horizontal, vertical, diagonal, etc.

While the first image is made, the rest of the image area is masked off. The mask is made from black paper or cardboard and placed a few inches in front of the lens, the distance depends on the focal length of the lens and the

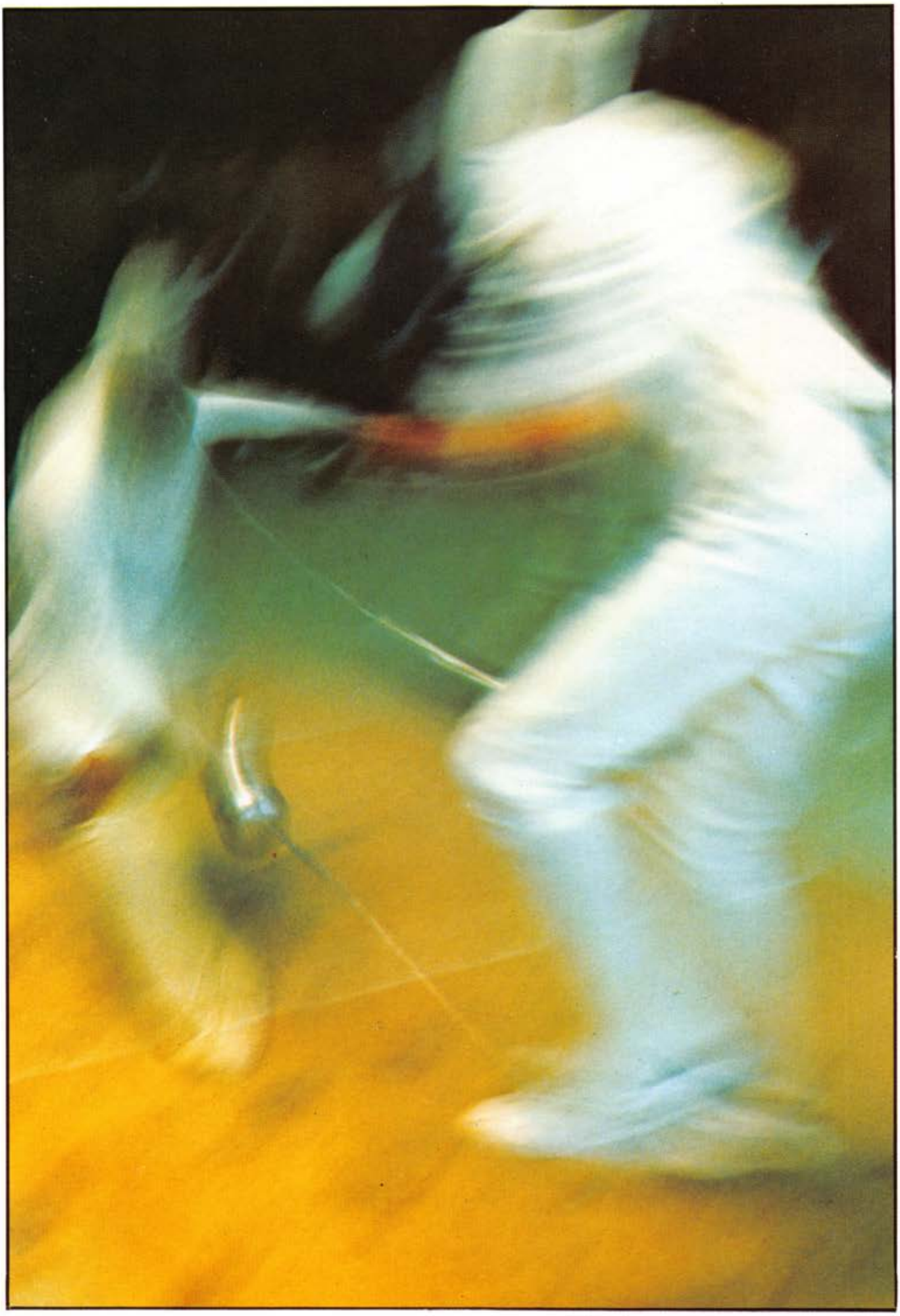
△Some portrait photographs benefit from the use of controlled soft-focus. Various types of diffusing materials can be used in the mask holder of the professional lens shade or alternatively Softar supplementary lenses may be fitted. Bo Timback.

△*Children, though ideal subjects for photography, can demand a lot of patience on the part of the cameraman. Note how the black background emphasizes the girl's blonde hair and the square format reinforces that touch of petulance.*
Joachim Pfaff.

△Indoor portraits require careful lighting not only to maintain the colour balance but also to create the right emphasis and atmosphere. The dark surroundings here stress the facial features whilst the light-coloured wall prevents the picture appearing too dark. A. Särchinger.

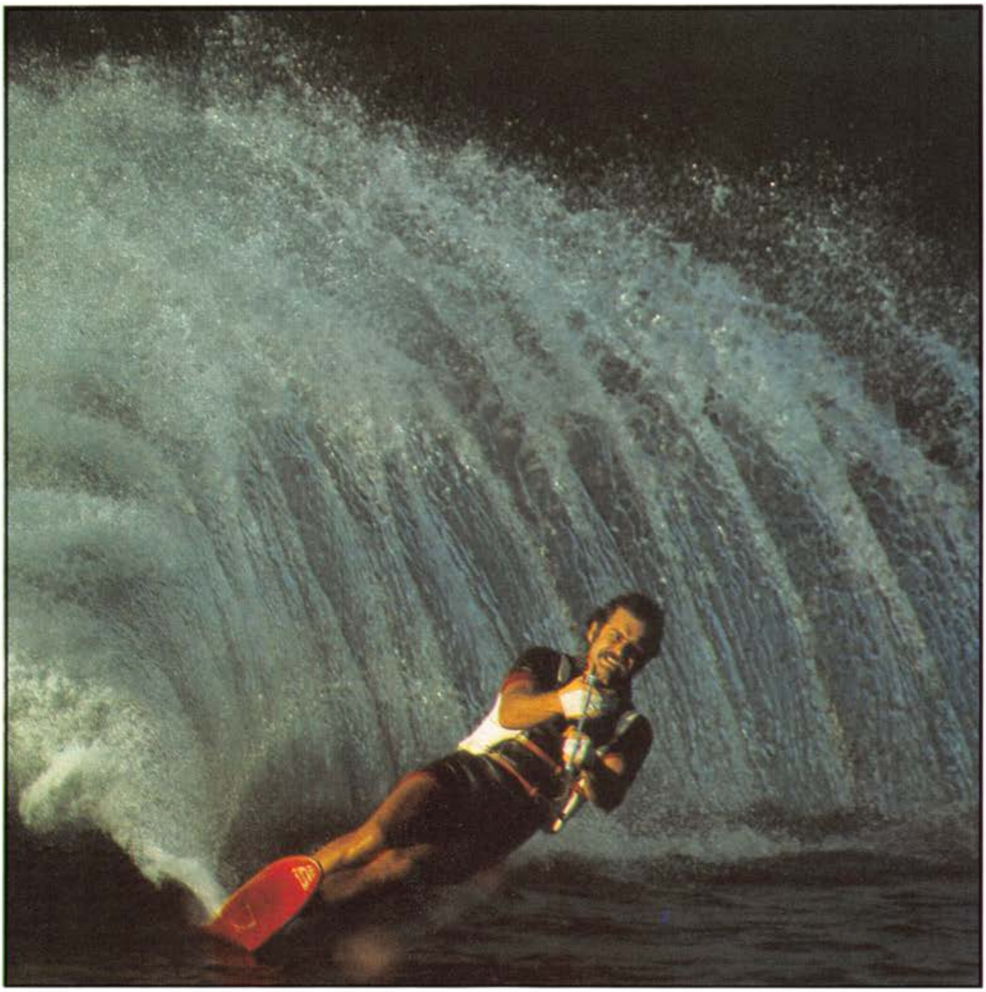
△Outdoor portraits often have a more natural appearance. Here the browns of the tree trunks match well with the boy's clothing and facial features. At this range the shallow depth of field of the 150mm lens gives a pronounced separation between subject and background. Ernst Wildi.

△The square format can add a great deal of strength and interest to a photograph that would be lost on the 24 × 35mm format. Try masking areas of this picture to make a rectangular shape and compare the effects of both compositions.
Michael Gnade.



◁*The electronically controlled focal-plane shutter of the Hasselblad 2000FC can be triggered by closing an external electrical circuit as in the fencer's foil and clothing. The shutter speed for this photograph was chosen to blur the subject's movement rather than render it sharp.* Erich Baumann.

△*This photograph was taken with a Tele-Tessar f8 500mm lens which allows you to shoot from a distance without disturbing the subject. The shallow depth of field emphasizes the subject whilst the necessarily long exposure blurs the birds wings and adds movement.* Albert Lauw.



△The 2000FC provides fast accurate electronically controlled shutter speeds which are ideal for freezing action in sports photography. Note how the water is frozen in mid-fall. A longer shutter speed would have given a different effect.
Bo Timback.

△Photographs of dim subjects taken with long focal length lenses need long exposures where meter readings may be unreliable. In all such cases, use bracketted exposures. If you mark your shooting position you can repeat the shot when the sunset is more picturesque. Fridmar Damm.

△*Sunsets call for very rapid reactions! This effect of a sunset on the glass-walled twin towers of the World Trade Centre lasted only a few minutes. The dim Manhattan skyline provides a good contrast to the brilliant highlights of the reflected sun.*
Ernst Wildi.

△*This picture has no definite point of interest to catch the eye at a first glance; instead each item is of almost equal interest and the eye is guided around the picture. In a rectangular frame the distribution and position of the individual items would be lost.* Michael Gnade.

△*This picture would have been impossible without the Hasselblad professional lens shade which, by virtue of its variable position, removes any light not directly part of the image. Note how the monochromatic effect emphasizes the silhouette.*
Hakan Berg.

△Photographing children requires you to keep on your toes! A long focal length lens is an asset for this type of shot but to keep a fast moving object in focus until you release the shutter, the Hasselblad quick-focusing handle on the lens may help.
Lars Gustafsson.

△*The noise of the pre-release mode, used to reduce camera movement when the shot is fired, can produce interesting reactions in the subject. These cats pricked up their ears; a human subject may relax, thinking the shot has been taken.*
E.A. Baumbach.

△*The telephoto lens is a standard item for wildlife photographers. The Variogon 140-280mm lens, with its stepless focal length adjustment, is equivalent to a whole series of fixed length lenses, but, being smaller and of less weight, is easier to carry.* Bertil Pettersson.

△Photographs are not necessarily exact reproductions of reality. In this picture, a multiprism lens was used to create the photographer's impression of spring. The Hasselblad accessory range includes a wide selection of special filters which can give extraordinary results. Bart Mulder.

shooting aperture. As a rule, the longer the lens and the larger the aperture, the further away the mask must be. Since it is usually more practical to place masks relatively close to the lens, standard and wide-angle lenses are usually more practical. Place the mask in the Hasselblad professional lens shade and mark the split line on the ground glass. Close the diaphragm to the shooting aperture and expose normally. For the second exposure place the mask so it covers the exposed area of the film. That is where the masking on the ground glass becomes important. If the dividing line is to be as unnoticeable as possible, the mask is placed so that it just reaches the dividing line. For a black dividing line leave some space; for a white line, have some overlap.

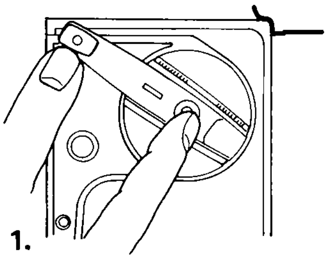
Instead of splitting completely different images, the background image can be continuous with only the foreground changed. As an example, the same person can appear twice in the same image, on the right and left side of a tree. Since the background is to appear as a continuous image, any visible dividing line must be avoided, otherwise it may reveal the technique used. Plain, light backgrounds are not recommended for this purpose since the slightest variation in density becomes visible. Select a darker background with irregular patterns —treetrunks, fences, pieces of furniture, curtains, window panes, corners of buildings, horizons or anything else that follows the dividing line.

Double exposure or sandwich?

Double exposures and sandwiches are both combinations of two or more images. While such images might look alike on the final print or when projected on the screen, there is a major difference which largely determines which technique must be used.

On a double exposure produced in the camera, the second image is visible mainly in the darker areas of the first. It is less visible or not visible at all in light and completely white areas. When two images are sandwiched together, it is just the opposite. The second image is visible mostly in the light and clear areas of the first, hardly, or not at all, in the dark sections. For sandwiches, images with white or light areas, therefore, work best. Double exposures require images with dark areas. Remember that in a slide the dark areas of the subject are also dark, the light areas are also light. On a negative, it is reversed: dark areas are light, light areas are dark. Fascinating and interesting results can be obtained by combining two or more images and it is therefore worthwhile to examine combinations of slides in front of a lightbox.

On the 2000FC, the double exposure prevention can be bypassed so that double and multiple exposures can be made without the need to remove the magazine. To cock the shutter and make the 2000FC camera ready without advancing the film, depress the slotted mirror programme disc in the middle of the winding crank. Keep it depressed as you start turning the crank. At the end of the turn, the camera is ready for the second exposure but the film is still on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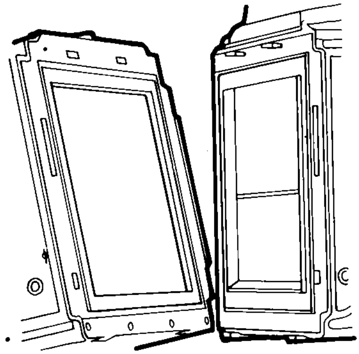
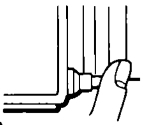

2.

1 To make a double exposure on the 2000FC, take the first exposure as normal but wind on while depressing the mirror programme disc with the index finger. This ensures that the gear that connects to the film transport in the magazine will not turn and, therefore, not advance the film. **2** On the other Hasselblad models, the magazine must be lifted away from the camera when winding on so that the gear in the camera body does not turn the film advance gear in the magazine.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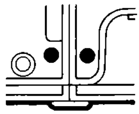
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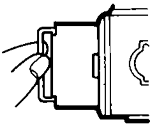
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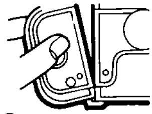
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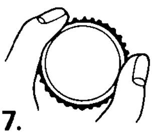
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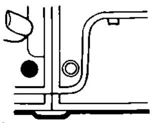
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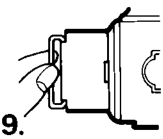
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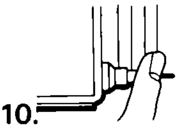
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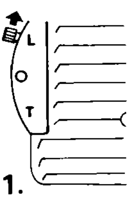
To make a double exposure on the 500C/M or Superwide C, make the first exposure as normal (**3**); both operating signals will then be red (**4**). Insert the darkslide (**5**) and lift the magazine away from the camera (**6**). It is not necessary to remove the magazine completely; tilting it away from the camera enough to disconnect the gear is sufficient. Turn the camera winding knob or crank (**7**). Reattach the magazine (**8**) which is still showing a red operating signal while the camera shows white. Remove the darkslide (**9**) and make the second exposure (**10**). Both operating signals will then be red.



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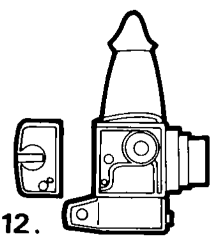
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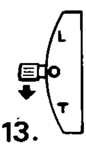


13.

To make a double exposure on the 500EL/M, do *not* release the camera for the first exposure with either the release button or a remote release. Instead move the time lever to the 'T' position (**11**) which releases the shutter but does not start the transport mechanism. Insert the magazine slide and remove the magazine from the camera (**12**). Move the time lever back to 'O' (**13**) which sets the transport cycle going and retensions the camera. Replace the magazine and make the second exposure as normal.

the previous frame. Double exposures with perfect registration should be possible provided that the camera does not move while the crank is turned.

The film advance override does not exist in the other Hasselblad models. The film magazine must be lifted away from the camera body so the gears between camera and magazine are disconnected when the shutter is cocked. Since the magazine with film is removed, perfect registration cannot be guaranteed, but can be obtained as the magazines normally fit on the camera bodies without any play. Removing and attaching must be done carefully to avoid even the slightest camera movement. After the first picture of a double exposure has been made, the operating signal in the camera is white, the one in the magazine is red. The camera works just as well and in exactly the same way as when both signals are white.

Because of Hasselblad's magazine interchangeability, the second exposure need not be made immediately after the first. The film magazine with the first exposure can be placed aside until needed for the second exposure while another film magazine is used in the meantime. This offers interesting and extremely valuable possibilities in every field of photography, especially weddings, which otherwise could only be made if two cameras were available.

13

Lenses

Image-forming qualities

Lenses are distinguished and separated mainly by their focal length, i.e. the distance at which a lens forms an image of a distant subject. For a single lens element, it is the distance from the element to the image point. On a compound lens (a lens consisting of several elements), like all Hasselblad lenses, the focal length is measured from the rear nodal point (or principal plane H), which can be anywhere inside the lens or even outside it. Since the focal length is engraved on every lens, there is no need for us to know the position of the principal plane, but it is given on the specification charts for all Hasselblad lenses.

Focal length is an optical characteristic which is built into the lens. It can be changed only by adding or removing *optical* components, such as a tele extender or a wide-angle attachment. A Proxar or close-up lens is also an optical component. It changes the focal length, but the change with the normally used Proxars is so small as to be negligible. The purpose of adding a close-up lens is not to change the focal length but to allow photography at closer distances.

The focal length of a lens is the same regardless of whether it is used on a camera, enlarger or projector. Focal length is also unchanged by adding extension tubes or bellows, which simply move the lens physically further away from the film plane, or by switching a lens from one camera to another or using a lens for different film formats. For example, a 150 mm lens remains a 150 mm lens whether used on a 4×5 in, 6×6 cm or 35 mm camera.

On zoom lenses, focal length can be changed within a certain range by moving some of the components inside the lens.

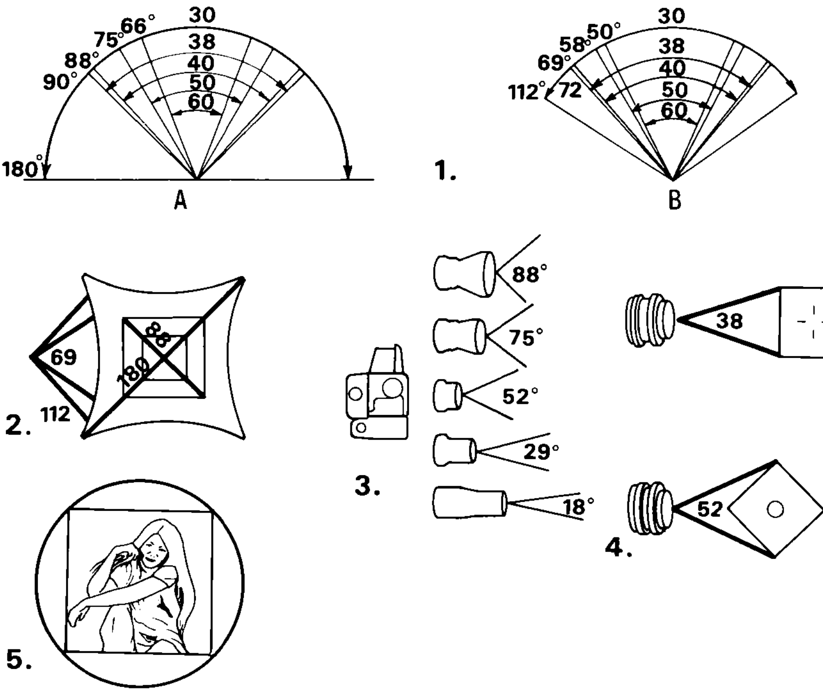
To classify lenses into standard, wide angle and long focus consider the focal length in relation to the format. A lens is considered normal when its focal length is about equal to the diagonal of the picture format for which it is used, e.g. 80 mm is normal on Hasselblad because the diagonal of the $2\frac{1}{4}$ in square is 78 mm. Lenses with longer focal lengths are classified as long

focus, those with shorter focal lengths as wide angles. Most long-focus lenses are telephotos, that is, they are physically much shorter than their focal length, so it is common to call all long-focus lenses 'telephotos' or 'tele lenses'.

When the 80 mm lens is used for Superslides it can no longer be considered normal because the diagonal of the 38 × 38 mm Superslide is only 58 mm; so the 60 mm Distagon, which is a wide angle for the $2\frac{1}{4}$ in square, then becomes the standard for the Superslide.

Angle of view

The angle of view, as the name indicates, is the angle the lens 'sees' when used on a specific camera. The angle of view can be related to the picture format in



1 The angle of view of the Hasselblad wide-angle lenses from 30 mm to 60 mm. The diagonal angles are shown in A; the angles relating to the $2\frac{1}{4}$ in side dimension are shown in B.
2 On a full frame fish-eye lens like the 30 mm Distagon, the 180° diagonal angle of view is completely out of proportion to the 112° horizontal or vertical angle which makes the lens different from a regular wide angle and gives the images the curved lines. Diagonally, the 180° coverage is twice as much as the 88° or 90° of the widest wide angle.
3 The focal length of a lens in relation to the picture format determines its angle of view. The longer the lens the narrower the angle of view for the same format.
4 The angle of view can be expressed in relation to the picture diagonal or the horizontal or vertical side. The two are different.
5 Covering power of a lens is the diameter of the circle within which satisfactory image quality and illumination is obtained.

at least two ways: in relation to the diagonal, or to the vertical or horizontal side. On the $2\frac{1}{4}$ in square format, the vertical and horizontal lengths are equal. As an example, the 80 mm lens used with the $2\frac{1}{4}$ in square has a horizontal angle of 38° and 52° diagonally. Used on $4\frac{1}{2} \times 6$ cm the view is still 38° horizontally, but only 46° diagonally and 28° vertically. For any specific format, the angle of view is inversely proportional to the focal length.

Any lens that has a diagonal angle of approximately 50° is considered standard; when the diagonal angle is larger they are considered wide angles, and when it is smaller, long focus.

EQUIVALENT FOCAL LENGTHS FOR DIFFERENT FILM FORMATS

	Focal length of lenses (mm)				
Horizontal angle of view (degrees)	4.5 × 6 cm and $2\frac{1}{4} \times 2\frac{1}{4}$ in (54 × 54 mm)	Superslide (40 × 40 mm)	35 mm (24 × 36 mm)	6 × 7 in (54 × 68 mm)	4 × 5 in (98 × 120 mm)
84	31	23	20	38	67
72	38	27	25	48	83
69	40	29	26	50	87
65	43	31	28	54	93
62	46	33	30	58	101
58	50	36	33	63	109
54	54	39	35	68	117
49	60	43	39	75	130
40	76	55	50	96	167
38	80	58	52	100	175
36	84	61	55	105	183
32	100	73	65	125	218
30	105	76	69	131	229
26	120	86	78	150	261
24	130	95	85	163	283
23	135	97	88	169	295
21	150	108	100	190	330
15	206	150	135	259	450
13	250	180	163	314	545
10	306	220	200	383	667
9	350	255	229	439	763
7	458	330	300	575	1000
$6\frac{1}{2}$	500	365	327	627	1090

Area coverage

The angle of view determines two things: the area coverage and the magnification. The area coverage for any lens is directly proportional to the subject distance. At twice the distance, a lens covers an area twice as wide; at half the

distance, the lens covers an area half as wide. A lens with a larger angle of view covers a larger area. The larger area coverage means that the subjects are recorded smaller, since the magnification is lower.

Covering power

Covering power is not the same as area coverage. Lenses are designed to cover a certain negative size. Lenses for a $2\frac{1}{4}$ in (54×54 mm) square camera are designed to produce the promised image quality and corner illumination on the $2\frac{1}{4}$ in (54×54 mm) square and not beyond. This is called covering power. The covering power depends on the design of the lens, not the focal length, for instance 50 mm lenses are made for 35 mm, $2\frac{1}{4}$ in square (54×54 mm), 4×5 in (98×120 mm) and perhaps even larger format cameras. Since all lenses produce a circular image, the covering power of a lens can be indicated by the diameter of the circle in which definition and illumination are satisfactory. If lenses designed for a small format camera are used on a large format camera, the corners are beyond the covering power of the lens. They may be completely cut off or the illumination and image quality in the corners may be unsatisfactory. Lenses designed for a large format camera, however, can be used for a small format, for example 4×5 in (98×120 mm) lenses could be used on a $2\frac{1}{4}$ in (54×54 mm) square camera and Hasselblad $2\frac{1}{4}$ in (54×54 mm) lenses can be used on 35 mm cameras.

Tele extenders

Tele extenders are optical components consisting of two or more lens elements. Mounted between camera and lens, like extension tubes, they increase (usually double) the focal length of the lens used in front of it so that, for example, a 150 mm lens then becomes a 300 mm. Instead of purchasing a longer focal length lens, you can purchase at less cost a tele extender, which is then used to increase the focal length of all lenses. Such an addition cannot be made without losing something, in this case both light and quality. The maximum aperture of the lens is reduced by two *f* stops, i.e. the *f*4 150 mm lens becomes a 300 mm *f*8.

When lens components are added to a well corrected lens, image quality changes. In what way and by how much depends completely on the lens with which the tele extender is combined and therefore varies from one lens to another. In general, the fall-off in quality is mainly at the edges, and may not be objectionable in portrait photography for instance. The quality can also be corrected, or at least improved, by stopping down the lens. As a general guide, when using the extender the quality becomes satisfactory or acceptable when the diaphragm is closed down two stops. As an example, a 250 mm lens with tele extender must be used at *f*22 to produce good 500 mm quality

(aperture of a 250 mm lens is $f5.6$, a loss of two stops makes the 500 mm focal length $f11$, and two stops less for loss of quality makes it $f22$).

While tele extenders combined with Hasselblad lenses do not equal the performance of a Hasselblad lens alone, they are a good compromise and enable you to photograph with different focal lengths lenses at a low cost.

Long telephotos at close range

As the focal length increases, so usually does the minimum distance at which the lens can be focused. The relatively long focusing distances of tele lenses give some photographers the impression that these long lenses are meant for long distance photography only. This is not so. The focusing distances are limited for mechanical design reasons. Tele lenses can be used at closer range in combination with close-up accessories, Proxars or extension tubes, depending on their diameter.

CLOSE FOCUSING RANGE FOR 500 mm TELE-TESSAR WHEN USED WITH TUBES

Extension tubes (mm)	Distance setting (ft)	Distance of subject to filmplane (ft)	Area (in sq) (Mag. 12)
21	Infinity	34	51 × 51
	28	15	19 × 19
55	Infinity	15	20 × 20
	28	10.6	12 × 12
21 + 21	Infinity	18.4	26 × 26
	28	11.6	14 × 14
21 + 55	Infinity	12	14 × 14
	28	9.4	10 × 10
55 + 55	Infinity	9.4	10 × 10
	28	8.1	$7\frac{1}{2} \times 7\frac{1}{2}$

Aperture

The lens aperture determines how much light reaches the film at a given moment. The f number is the focal length of the lens divided by the working diameter of the lens. It used to be said that the working diameter was the diameter of the front element, which can be the case on some lenses but does not apply to other lens designs. The working diameter is the diameter of the entrance pupil, known only to the lens designer but also found on the Zeiss lens specification charts.

LENS SPECIFICATIONS

Lens	Type	Minimum focusing distance		Area coverage at minimum distance		Minimum	Angle of view			Length at
		feet	metres	inches	cm	aperture	Horizontal	Diagonal	Weight	infinity (mm)
80 mm f/2.8 Planar	C	3	0.9	20	50	22	38	52	465g	51.7
80 mm f/2.8 Planar	F	2	0.6	12	30	22	37	51	460g	60
100 mm f/3.5 Planar	C	3	0.9	15	37.5	22	32	43	610g	62
105 mm f/4.3 UV Sonnar	C	6	1.8	27	67.5	32	30	41	670g	87
110 mm f/2 Planar	F	2.6	0.8	12	30	16	28	39	750g	87
120 mm f/5.6 S Planar	C	3	0.95	12	30	45	26	36	640g	86.5
135 mm f/5.6 S Planar	C	bellows		2.25	5.5	45	23	32	560g	85
150 mm f/4 Sonnar	C	5	1.4	17	42.5	32	21	30	710g	96
150 mm f/2.8 Sonnar	F	4.6	1.4	14	35	22	21	30	680g	87
250 mm f/5.6 Sonnar	C	8.5	2.5	16	40	45	13	18	930g	156
250 mm f/5.6 Sonnar Superachromat	C	9	2.8	17	42.5	45	13	18	760g	155
350 mm f/5.6 Tele-Tessar	C	16.5	5	26	65	45	9	13	1450g	225
250 mm Tele-Tessar	F	8.5	2.5	16	40	32	13	18	—	—
500 mm f/8 Tele-Tessar	C	2.8	8.5	29	72.5	64	6.5	9	2130g	316
60 mm f/3.5 Distagon	C	2	0.6	16	40	22	50	66	645g	85
50 mm f/4 Distagon	C	1.6	0.5	14	35	22	58	75	885g	100
50 mm f/2.8 Distagon	F	1	0.32	6	15	22	56	74	1230g	112
40 mm f/4 Distagon	C	1.6		36	90	32	69	88	1375g	124.5
38 mm f/4.5 Biogon	SWC	1	0.3	38	95	22	72	90	1310g	153
30 mm f/3.5 F-Distagon	F	0.96	0.3		0.5	22	112	180	1370g	115.5
140–280 mm f/5.6				36	90					
Variogon	C	8.2*		14–28	35–70	45	16[1]	30[1]		
140–280 mm f/5.6 Variogon	F	3.5**	0.75	12	30		11[2]	22[2]	1870g	240

*in normal focusing **in macro [1]at 140 mm [2]at 280 mm

True telephotos

An optically true telephoto is a specific design of a lens with a positive front and a negative rear section. The principal plane, from which the focal length is measured, is not within the physical dimension of the lens as on an ordinary design, but somewhere in front of the lens, to be specific: 23 mm in front of the Sonnar 250 mm; 47 mm in front of the Tele-Tessar 350 mm; and 125 mm on the Tele-Tessar 500 mm.

Retrofocus lenses

In an optically true wide-angle lens the rear nodal point from which the focal length is measured is within the physical dimension of the lens. The shorter the focal length, the closer the lens must be to the film plane.

On single-lens reflex cameras, lenses cannot be placed close to the film because the mirror needs space to swing up and down between the lens and film. On all Hasselblad SLR cameras, the distance between the film plane and lens seat is 74.9 mm, making the use of the wide-angle lenses below 80 mm impossible. Lens designers have found a solution by designing lenses where the rear nodal point is behind the lens. This can be confirmed from the lens specification sheet. On the 60 mm Distagon, the nodal point is listed as 11 mm behind the rear element; on the 50 mm Distagon, 19 mm behind; on the 40 mm Distagon, 29 mm; and, on the 30 mm Distagon, 40 mm.

Retrofocus lenses are sometimes also called 'inverted telephotos', as the front section is negative, the rear, positive, i.e. the opposite from a true telephoto. The front element of retrofocus lenses is larger than you would expect of a short lens and larger than on an optically true wide-angle of the same focal length and speed. In the Hasselblad line the Biogon is a true wide angle; the Distagons are retrofocus types.

Lens quality

A single lens element produces an image affected by all kinds of faults called aberrations: spherical and chromatic aberration, coma, astigmatism, field curvature and distortion. Such an image is hardly acceptable to a serious photographer. The aberrations can be reduced by combining various lens elements with different curvatures and thicknesses, made from different glass and arranged in different ways within the lens mount. It is the lens designer's job to find a combination which reduces all aberrations to a point where they are not visible or objectionable in the applications for which the lens is made.

The above statement might perhaps lead to the conclusion that a greater number of elements automatically means better quality. While large aperture lenses and extreme wide angles do require more elements, the quality of the complete lens is not determined by the number of elements, but by the skill of the designer in combining the minimum number of elements to produce the

maximum in quality, using the latest types of glass and design techniques. The quality of the final lens is determined even more by the accuracy with which each lens element and each mechanical component of the lens mount is made and assembled, and how carefully and thoroughly the finished lens is tested.

The overall sharpness or quality of a lens used to be, and still is in many cases, expressed by resolution, i.e. the number of lines per millimetre a lens is capable of reproducing as separate lines.

Lens and photo technicians have, however, found that image quality in a photograph is not so much determined by the resolution of fine detail as by the manner in which the more easily perceptible, larger structural elements in the picture are reproduced. This is more a question of contrast rendition. Edge sharpness, called acutance, is what gives a photograph the appearance of sharpness and not resolution detail. Frequently, high acutance goes together with high resolution, but not always. It has been demonstrated that it is possible to produce a poor photograph even if it has a high resolution, and a good picture with a lens that has moderate resolution. Resolution frequently fails to conform to the subjective judgement of overall sharpness, while values of acutance correlate very well with the observer's feeling for sharpness.

The image-forming qualities are expressed through the rendition of contrast with MTF (Modulation Transfer Function) diagrams. Zeiss have no secrets about their lens quality; MTF diagrams are readily available for all the Zeiss lenses used on Hasselblads. Unfortunately, they mean little to the layman, and are little use to the photographer who would like to compare the Hasselblad lenses with those of other cameras as the same test data are not available from other companies. The diagrams, however, show whether and how much Hasselblad lenses improve by stopping down the aperture. They show and confirm other interesting facts within the line of Hasselblad lenses and can help in selecting a lens for a special purpose.

Image quality at small apertures

Image sharpness improves as the lens is stopped down; however, beyond certain limits the nature of light affects the sharpness. Light pouring through any opening spreads slightly at the edges, an effect known as diffraction. This becomes a problem in photography only when the aperture is very small. The minimum aperture of high quality lenses is usually limited to a point where the degradion of the image is not noticeable. For all practical purposes, the Hasselblad photographer need not be concerned about closing the aperture too far and losing quality. So do not hesitate to stop the lens down completely if the depth of field requires it, as the unsharpness caused by limited depth of field would be more noticeable than the loss of overall definition caused by diffraction.

As a general rule, best image quality appears not at the smallest aperture, but two to three *f* stops below the maximum (*f*5.6–*f*8 for an *f*2.8 lens).

Your own quality tests

As MTF diagrams are not readily available for many lenses and are of little practical value to anyone except the optical expert, you can make your own comparison tests by photographing the readily available lens test charts or any other flat object with fine details, such as a newspaper page. You should observe the following points:

1. Make certain that each lens covers exactly the same size area.
2. Make certain that each negative or transparency has exactly the same exposure and development.
3. Make certain that the test target is lighted evenly and identically for each lens.
4. The test target must be absolutely flat so that all is evenly focused. The filmplane must be parallel to the test target.
5. Eliminate any possibility of camera motion.

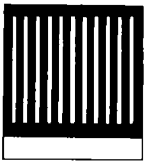
When evaluating the results, look at the actual negative or transparency with an 8 × to 20 × magnifying glass. Never evaluate prints made from a negative or slides projected on a screen as too many other factors can enter and distort the results. Evaluate the centre and corners.

Colour correction

Simple lenses bring lights of different colours to different points of sharp focus, which is unsatisfactory for most photography. One of the main reasons for using a complex lens is to reduce this problem. Most photographic lenses are *achromatic*, which means that they are fully corrected for light of two colours, and fine for most photography. *Apochromatic* lenses are fully corrected for all three colours, and show a marked improvement in reproduction of fine detail. *Superachromatic* lenses are a Zeiss speciality. They are fully corrected for all light, and for infra-red radiation (from 700–1000 nm). The 250 mm *f*5.6 Zeiss Sonnar Superachromat is ideal for infra-red photography and produces much higher resolution and acutance than do normal long focal length lenses.

Multicoating

For over 20 years, all good photographic lenses have been coated, meaning that glass-air surfaces are covered with a thin layer of a fluoride which reduces the amount of reflected light. When light hits a non-coated glass surface, about 5% is reflected and the transmitted light is therefore reduced to 95%. A 5% loss of light is not serious. In a good photographic lens, however, there may be 8, 10 or even more surfaces where glass meets air or vice versa, and if



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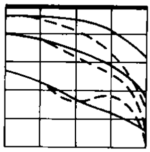

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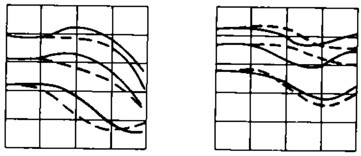
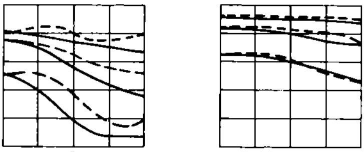
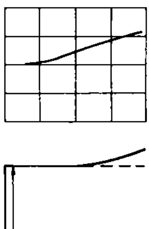


3. A B



4. A B

The quality of a photographic image is not so much determined by the number of lines that are resolved (**1**) but by the edge sharpness which is called acutance. The acutance of all Hasselblad lenses is readily available on published MTF diagrams (**2, 3** and **4**). The image height is on the horizontal axis with the centre at the left and the extreme corner at 40. The side edge of the $2\frac{1}{4}$ square is at approximately 28. While these diagrams do not mean much to the layman, they do allow a comparison of the quality and characteristics of different lenses. The diagrams shown are for the Distagon 60 mm (**2**), the Planar 80 mm (**3**A), the Planar 100 mm (**3**B) and the 120 mm Planar S used at infinity (**4**A) and at close distances (**4**B).



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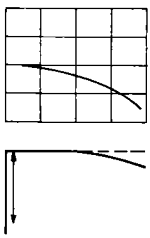

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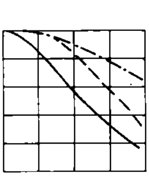
The distortion diagrams also indicate whether the lens has barrel or pincushion distortion. If the curve has a positive value, it means that the actual image point in the corner is further from the image centre than it would be with a perfect, distortion-free image, so the lens has pincushion distortion (**5**). A curve with a negative value indicates barrel distortion as the image point is closer (**6**).



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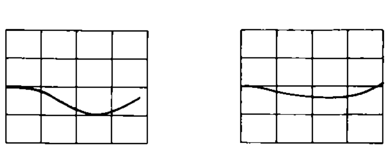


8. A B

7 The relative illuminance for all Hasselblad lenses is also published. The image height is again on the horizontal axis with the center at left and the corner at the right.

Distortion is also shown in a similar diagram in percentage of the relevant image height. The two diagrams show the difference in distortion between the Distagon 40 mm (**8**A) and the Biogon 38 mm (**8**B).

each surface reflects 5%, the total light loss may amount to 40–50% or more.

Of even more concern than the loss of light, is what happens to the reflected light. After being reflected, it probably reaches another lens surface and is reflected back to another lens or part of the lens mount. The reflected light causes flare—a haze over the image which reduces its contrast. A thin coating over the lens surface reduces light reflection to about 1%. All Hasselblad lenses for 500C, 500EL and Superwide models are coated.

Applying several layers to each surface further reduces reflections, to about 0.3%. In a multicoated lens, each element has several coatings, each of a different thickness, so that each eliminates the reflection for a different wavelength of light. Light transmission is increased and the reduction in flare can be significant. Reduction of flare, however, depends greatly on the design and focal length of the lens. The improvement is most noticeable on wide-angle lenses, and least noticeable on those of longer focal lengths.

With some multicoated lenses, the Distagons for example, you can photograph directly into the sun or other light source, without picking up objectionable flare. Multicoating is most helpful when photographing against white backgrounds or directly into a light source when a lens shade cannot protect the lens. In all other cases a lens shade can do more to prevent flare.

Zeiss multicoated lenses are engraved with the T* designation. Only lenses with this engraving have the multicoating which consists of six layers (one for each major colour) on each glass-air surface. The Schneider Variogon 140–280 mm zoom is multicoated, but does not carry the T* designation. Zeiss lenses without T* have the regular one layer coating and, used with the proper sunshade, also yield images with excellent contrast, shadow and highlight detail.

Relative illuminance

Every lens has a lower illuminance at the edges. It changes with the aperture and must therefore be evaluated with the lens wide open and closed down. The data for relative illuminance are published by Zeiss for all Hasselblad lenses. While the curves might give the impression of a considerable fall off, the relative illuminance is within the range where it is not objectionable, or even noticeable, on the negative or slide.

Colour rendition

Many types of glass used in modern lenses are not absolutely clear but have a tint of one colour or another and therefore act as a colour filter. While the eye adjusts easily to different colours when viewing individual images, accurately matched colour rendition in all lenses is extremely important in photography. The lenses in the Hasselblad system, including the Schneider zoom, are all

carefully matched for colour rendition. You can switch from one lens to any other lens and be assured of a perfect colour match without the need to use any colour balance filters.

Distortion

Distortion is the lens' inability to record straight lines as straight lines over the entire film area. Straight lines near the edges appear curved, either inward, referred to as pin-cushion distortion, or outward, called barrel distortion. In some photographic fields, such as portraiture, the degree of correction is less critical than in architectural, product and scientific photography. Lenses used for photogrammetry must be free of distortion. The distortion correction for the Zeiss Hasselblad lenses is published.

Other image distortions

Photographers call various other effects which appear in photographic images 'distortion'. This is not strictly correct as these effects are not caused by a fault in the lens. For example, foreshortening is caused by shooting at a short distance; slanting vertical lines, on a building for instance, are caused by the tilt of the camera. This is not a fault in the lens or camera, it is a normal way of seeing. Looking up at a skyscraper, the lines converge as they recede into the distance. With a wide-angle lens, the slanting can be enhanced. Any vertical slant may appear unreal when shown on a piece of photographic paper or projected on a flat screen.

Another type of distortion occurs when solid subjects are photographed with wide-angle lenses, the objects near the edge of the picture appear wider than those in the centre. This is most objectionable when photographing groups of people. The lens cannot be blamed for this effect; it recorded the subject just as it appeared, in the same way as you would have seen it. The lens views the people in the centre of the group from the front, but those at the end of the group from the side. This so-called 'perspective distortion' does not occur with flat objects. It happens with all lenses but becomes obvious only with wide angles; the 'distortion' with a 50° angle of view lens is only 10%, but increases to about 40% with an 85°–90° wide angle.

Even a 10% distortion can be objectionable in some types of photography, for example in commercial photography when known symmetrical objects are shown at the edges or in photographs of an architectural interior. The solution is to frame the area so that such objects are away from the edges of the photograph, or use a longer focal lens to decrease the angle of view. In group pictures taken with extreme wide angles, turn those at the edge of the group towards the centre or arrange the people in a curve.

Lens design

The names on the lenses made for Hasselblad indicate a specific design of lens.

Planar lenses are of a symmetrical design with five to seven elements grouped into similar front and rear sections. The name is based on their characteristic ability to produce an exceptionally flat field, and therefore extremely uniform edge-to-edge sharpness. Most are designed for normal distance photography. *S-Planars* are corrected to produce the sharpest images with nearby subjects.

Sonnar lenses consisting of four to seven elements are of a very compact design with the main components in the front section producing, besides excellent sharpness, superb corner-to-corner illumination, both in the finder and on the film.

Tele-Tessars consist of a positive front section and a negative rear section separated by a large air space. Tele-Tessars with four to five lens elements are genuine telephoto lenses with the principal plane in front of the lens.

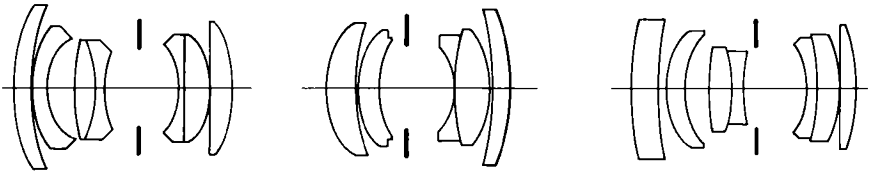
In the field of wide-angle lenses, Hasselblad offers two completely different designs. *Distagon* is a retrofocus-type wide-angle lens with the principal plane behind the rear element. Distagon lenses vary from 7 to 10 lens elements; the wider the angle, the more lens elements are necessary for corner-to-corner quality. *Biogon*, with eight elements, is an optically true wide-angle lens with the principal plane within the lens. The non-reflex Hasselblad Superwide C uses this lens which is unique in the medium format field.

Variogon is a zoom lens developed by Schneider in which the focal length is changed by moving some of the lens elements.

Biogon and Distagon

Retrofocus lenses have the same uses as true wide angles. However, long back focus makes it difficult, if not impossible, for the lens designers to correct a retrofocus lens to the same degree as a wide angle, especially over the entire focusing range. A compromise is therefore necessary.

The names of the Hasselblad lenses indicate specific optical designs. Planar lenses (**1**) are of a symmetrical design with similar front and rear sections. Sonnars (**2**) are triplet-type lenses with the main component in the front. Tele-Tessars (**3**) are true telephotos with a positive front and negative rear section. The Biogon (**4**) is a true optical wide angle while the Distagon (**5**) is a retrofocus-type wide-angle lens.



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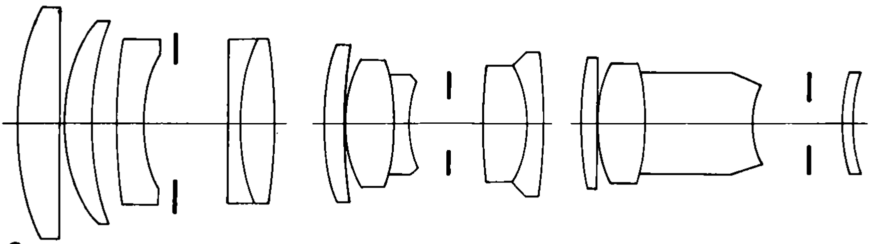

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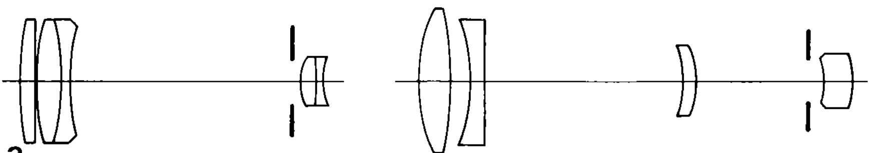

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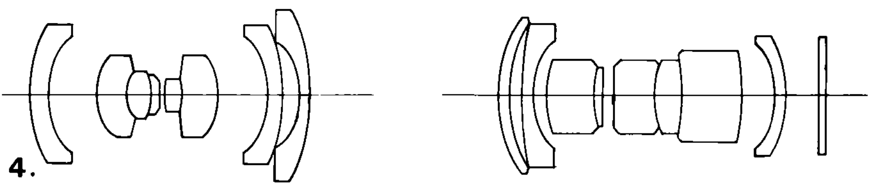

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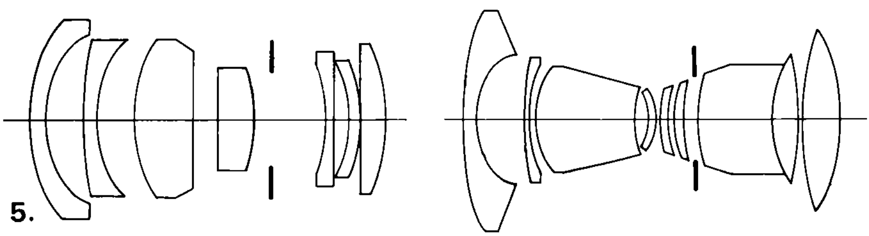

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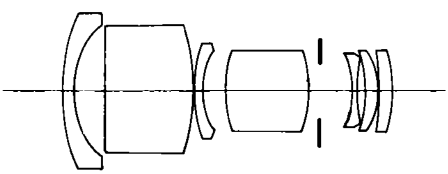


Retrofocus lenses such as the Distagons are made to provide the best image quality at long distances. Edge sharpness suffers somewhat at the near end of the focus range, but can be corrected by closing down the aperture. This is the reason for the lock at 3 ft on the 40 mm Distagon—a reminder to stop down the aperture for closer subjects if corner-to-corner quality is necessary. However, distortion and sharpness loss are so small as to be noticeable only in very critical work and when images are blown up to an unusual dimension. In general work they are never objectionable, or even noticeable.

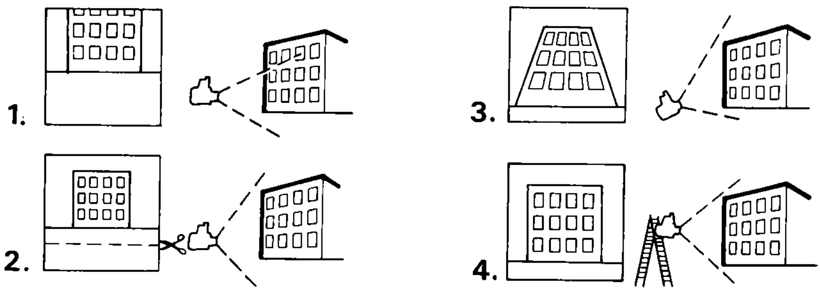
For the very best in corner-to-corner sharpness, for architectural, product, or scientific photography with a super wide angle, or for photogrammetric purposes which require 'view camera quality' without a trace of distortion, the Biogon 38 mm lens can be used. This produces the required quality at long distances and down to the 30 cm (12 in) minimum distance. The smaller size of the Biogon true wide angle allows use of the professional lens shade and the same 63 mm filters that fit the 50 and 60 mm Distagon lenses. The larger diameter of the 40 mm Distagon requires special large filters and sunshades.

Zoom lenses

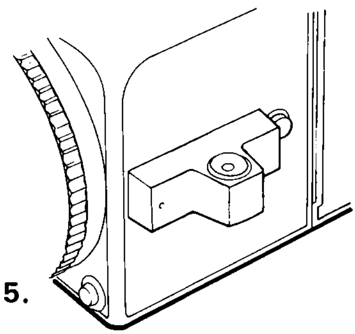
On the Schneider Variogon, the focal length is changed by rotating the zoom ring (between the focusing and aperture shutter speed controls) to move some of the lens elements internally. The ratio between the shortest and the longest focal length is known as the zoom range and is 2:1 or 2 × for the Variogon (280:140).

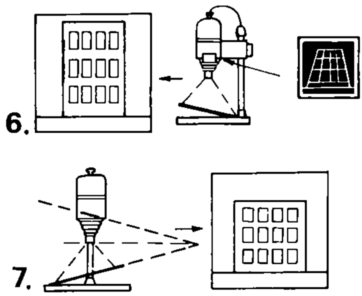
Zoom lenses have some obvious advantages. Firstly, they reduce the number of lenses that have to be carried. For example the Variogon 140–280 mm covers the telephoto range used by most Hasselblad photographers, and it can, therefore, be used instead of the 150 and 250 mm Sonnar lenses. This may enable you to cover all assignments with two lenses—the 80 or 60 mm and the Variogon. The maximum aperture *f*/5.6 of the Variogon equals that of the 250 mm Sonnar, and is one stop smaller than the 150 mm *f*/4. The decision on whether to use the zoom or 150 and 250 mm should be based on the loss of speed in the shorter focal lengths and the size of the lens. You may prefer to carry one larger and heavier lens, or two smaller and lighter ones. Another, perhaps minor, consideration is that the 150 and 250 mm Sonnars take the same size filters and shades as the 80 mm, whilst the Variogon needs its own size.

The Variogon can do more than simply replace the 150 and 250 mm lenses. It is capable of covering not only the area of the 150 mm and 250 mm lenses but anything in between, as well as a larger area (at 140) and a smaller one (at 280 mm). This gives a practically unlimited control of composition and is easier and faster to operate. If the composition is not satisfactory, it can be adjusted by simply turning the zoom control on the lens. There is no need to move the camera, or to refocus the lens.



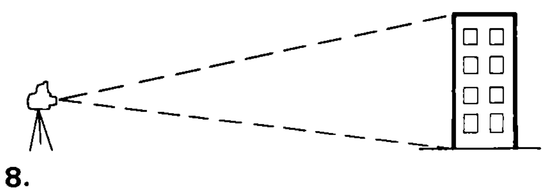
When the camera is too close to include the top of a building (**1**), a shorter focal length lens may solve the problem but a large undesirable area may then be included at the bottom (**2**). Another solution is to tilt the camera (**3**) although this results in slanted lines. Raising the camera slightly, for example with the use of a step ladder, frequently removes the necessity to tilt the camera (**4**). With extreme wide-angle lenses the camera need not be raised very much.





The accessory spirit level attached to the accessory rail (**5**) allows accurate and convenient levelling of the 500C/M 500EL/M and 2000FC cameras.

Slanted verticals can be corrected in the darkroom by tilting the easel (**6**) or, better still, tilting easel and negative carrier so that their planes meet in the plane of the enlarging lens.



A longer lens and a greater camera-to-subject distance (**8**) may allow you to photograph a building without slanting the parallel lines as the longer distance eliminates or reduces the need to tilt the camera.

In sports, action and news photography, a zoom lens has a more important advantage. It reduces or eliminates the need to change lenses. Lens changes are time consuming, mainly because the new lens needs to be set to the correct aperture, shutter speed and distance. There is also the problem of what to do with the lens that is removed and where to put it. While a lens is changed, the camera is unusable and this may just be the time when the most startling action takes place. On a zoom lens, the focal length can be changed without disturbing the lens settings. You are always ready to shoot and can take a long shot followed almost instantly by a closer view.

The image stays in focus only if the focusing is very accurate. To be assured of this, always focus on the ground glass with the lens at the longest focal length, regardless of the focal length that is actually used. At the longest focal length the image is at its greatest magnification, the depth of field is at the minimum and focusing is therefore most accurate. The Variogon also keeps its aperture over the entire zoom range.

The Variogon for close-ups

The focusing ring on the 140–280 mm Variogon is adjustable from 8 ft to infinity. Within this range, the lens can be used at any focal length. Closer photography is possible by pushing the button next to the zoom ring to 'macro'. The zoom ring can then be turned beyond the 140 mm setting. This does not change the focal length, which stays at 140 mm, but enables focusing from 8 ft down to $2\frac{1}{2}$ ft.

The focusing ring also changes the focus distance on the macro setting. With the macro ring at its extreme, the lens focuses at 1.01 m ($39\frac{3}{4}$ in) at infinity, covering an area 0.44 m ($17\frac{1}{4}$ in) square; at its 8 ft setting the lens focuses at 0.75 m ($29\frac{1}{2}$ in) and fills the frame with a subject area 0.33 m (13 in) square.

The built-in macro capability eliminates the need for close-up accessories in most cases. There can, however, also be a reason for attaching a close-up lens of the proper diameter at the front of the Variogon. A Proxar lens can be helpful at all distances of less than 8 ft as the focal length can then be varied. With a +1 diopter lens, for example, set at infinity, subjects at a distance of 1 m ($39\frac{1}{2}$ in) from the close-up lens can be photographed and are recorded sharply at all focal lengths from 140 to 280 mm.

Extension tubes are not normally used. When the distance of the lens seat to film plane is changed by the use of tubes, the subject does not stay in focus when the focal length of a zoom lens is changed.

Zoom effects

Zoom lenses not only duplicate the uses of fixed focal length lenses, they also have the unique capability of creating images in which the focal length

changes while the shutter is open. This changes the size of the subject and extends the highlights into streaks radiating from the centre. If you alter the focal length for the entire exposure time, the image consists of streaks only. The subject itself is hardly visible, if at all.

These types of images are more effective when the subject can be recognized and is simply surrounded by streaks. To produce this effect, keep the focal length at a fixed setting, usually either at the shortest or longest, for about half of the exposure time, and change it during the second half. Keeping it at 280 mm and zooming towards 140 mm gives a large subject with streaks going towards the centre. Keeping it at 140 mm produces a small image of the subject with streaks going towards the outside.

Effective zoom shots require subjects with bright areas, since these areas produce the streaks. The streaks produced by the highlights are most visible if they cross darker image areas. You can vary the length of the streaks by either zooming over the entire focal length range (for long streaks) or over a part only (for short streaks). Fast zooming produces faint streaks, slow zooming more pronounced ones.

A camera mounted on a sturdy tripod makes zoom shots easier, as exposure times must be long enough to be able to rotate the zoom ring during the time the shutter is open. It is possible to do this at 1/8 sec but the results may be questionable; 1 sec gives you much greater control. In low light levels, these long shutter speeds can be obtained without problem, but what about outdoors in bright sunlight? With ASA 64 film a shutter speed of 1/8 sec is the longest you can set even at the smallest (*f*64) aperture on the Variogon. The solution is to fit a neutral density filter that requires a change of 6 EV (6 *f* stops). With such a filter a sunlight exposure with 64 ASA should be around 1 sec at *f*16, two seconds at *f*22. If this is not available, use a three *f* stop filter (density 0.90) which requires a 1 sec exposure at *f*64.

Fish-eye lenses

Fish-eye lenses are so constructed that they produce curved images of all straight lines that do not pass through the centre of the image. The effect is one of greatly exaggerated barrel distortion, resulting in strangely beautiful curved images. Some produce a circular image that covers only the central area of the film. The effect can be striking, but it is largely the circular image that attracts attention. The subject, usually reproduced on a tiny scale, is often secondary. The effect wears off quickly, and the pictures start to look alike. The possibilities for cropping are slight, and, therefore, such lenses have very limited application.

Other fish-eye lenses including the 30 mm Distagon cover the entire format with no visible light fall off in the corners. The focal length is still long enough to produce a relatively large image in the centre, yet it also embraces surrounding subjects from corner to corner within a 180° field. Since the entire

image format is used, part of the image can be used and enlarged. The 'distortion' of the fish-eye lens is completely unrelated to sharpness. Good sharpness is obtained from corner to corner even with the lens wide open.

Filters and sunshades

The 180° diagonal angle of view of the 30 mm Distagon does not allow the placing of any accessories, filters or shades in front of the lens, as they would cut into the field of view. As far as a sunshade is concerned this limitation is not a serious drawback as the Distagon design and the multicoating have reduced flare to a degree where it is possible to photograph directly into a light source, including the bright sun, without any noticeable loss of contrast. The filter problem has been solved by making the front lens section removable and making space for small 26 mm filters inside the lens. The filter is screwed to the rear of the front section. When the lens comes from the factory, a clear glass is in place. This clear glass, or a filter, must always be there; without it the quality is no longer the same.

Four of the most common filters are supplied with the lens. Other types can be made up using the available filter mounts but remember that filter thickness is important. Every glass that is attached must have the same thickness as the filters supplied with the lens.

'Non-fish-eye' images

Fish-eye lenses are best known, and their images best recognized, through the curved lines which they produce. On the full frame Distagon design, however, lines need not necessarily be curved; images need not have the 'distorted' fish-eye look. All straight lines that intersect the centre of the field are recorded as straight lines.

The fish-eye look in scenic pictures is avoided, or at least reduced, by aiming the camera so that the horizon crosses the centre of the field. You can avoid obvious curves by careful placing of other subjects. For example, an image of trees in a forest can look like a wide-angle shot if the fish-eye lens is pointed up to the sky and the tree trunks are composed to go from the corners toward the centre. Circular subjects centred in the square remain as perfect circles. A doughnut, a balloon, the face of a clock, or a round plate, are recorded as they appear to the eye. Why then use a fish-eye? Because the fish-eye covers a 180° angle diagonally, and therefore includes a much larger background area than any other lens.

The most interesting fish-eye images are often those where the viewer is not aware that they were made with fish-eye lenses. It is this application which makes the full frame fish-eye superior to those lenses which produce circular images. Its use is practically unlimited; using the lens most subjects can be made into interesting images either with, or without, the fish-eye look.

The main reasons for using the 30 mm Distagon are:

1. To cover large areas. The 112° horizontal or vertical angle covers an area larger than the shortest wide-angle lens. The 180° diagonal coverage covers an area twice as large as the widest wide-angle lens.
2. To create an eye-catching image which presents an unusual view of a subject.
3. To produce images that are unusual because of the width of the 180° diagonal angle—not because of distortion.

Adapting Hasselblad lenses

It is possible to use Zeiss-Hasselblad lenses on other cameras. However, the lenses are designed to cover the $2\frac{1}{4}$ in square format and, therefore, do not produce satisfactory corner quality or illumination on larger formats, except when used for extreme close-ups. Set to infinity, the lenses form an image at a distance of 74.9 mm from the lens seat. This physical dimension when used on another camera must be the same if used at infinity, or longer if used for close-up photography.

The F lenses made for the 2000FC have no shutter and are, therefore, practical only on focal-plane shutter cameras. The aperture is opened and closed manually. The C lenses with Compur shutter can also be used on a camera with shutter. The shutter in the lens is simply left in the normal open position. The aperture is set manually, after depressing the manual stop down lever.

The shutter lenses might be considered a logical choice for use on non-shutter cameras. However, this is not so, because the lens shutter can only be operated through the camera coupling shafts. There are two solutions to this problem: either mount the lens on the bellows extension or on the front plate of the bellow extension. The front plate is not listed in the catalogue as it is a part of the bellows, although the Hasselblad distributor may be able to provide it separately. With this plate, or the entire bellows, the lens shutter is operated with a cable release. It is recocked by turning the knurled screw. The diaphragm also closes down automatically to the preset aperture and reopens fully when the shutter is recocked.

Adapting other lenses to Hasselblad cameras

It is possible to mount other lenses on Hasselblad cameras with the lens mount adapter. This light metal blank has the Hasselblad bayonet mount on one side; the rest of the adapter is just a metal block which a competent mechanic can machine to fit the lens that is to be used. This is possible only with lenses where the distance between the lens seat and film plane is at least a few millimetres longer than the 74.9 mm distance on the Hasselblad SLR cameras. If the distance were shorter, the lens would have to go inside the camera body.

When considering the use of other lenses, keep in mind that only lenses designed for the $2\frac{1}{4}$ in square, or larger, format will fill the $2\frac{1}{4}$ in format with adequate quality. 35 mm lenses are not likely to produce satisfactory results on the larger format, except for macro work and perhaps for Superslides. If the lens has a shutter, as most view camera lenses do, operation is no problem. It simply means separate triggering of the camera's rear curtain and lens shutter: two separate operations after each picture. Open the rear curtain by depressing the camera's release and keep it depressed until exposure has been made. Operate the lens shutter as normal, with or without cable release. Recock the shutter in the usual way. Advance the film by turning the winding crank. On EL cameras, the film is advanced when the finger is removed. If the lens has no shutter it can be used on the 2000FC without any additional accessory.

On the other models, the Hasselblad micro shutter (between lens and camera) provides shutter control from 1 sec to 1/500 sec, plus B and flash sync at all speeds. This is practical only if the lens-seat-to-film-plane distance of the lens is several millimetres longer than the combined distance of the camera (74.9 mm) and the micro shutter.

Hasselblad bodies on view cameras

Hasselblad camera bodies and film magazines can be combined with a view camera. Some view camera manufacturers provide a rear plate with an adapter to which a Hasselblad camera body can be attached by means of the bayonet lens mount. This allows all the roll films and the 70 mm film which are usable on Hasselblad to be used with a view camera.

This can produce interesting results when swing and tilt control is necessary in close-up work, or for special projects. The advantage may simply lie in the large film capacity of the Hasselblad magazines. Since the camera body is also attached, viewing and focusing on the camera's ground glass is possible.

Hasselblad lenses on enlargers

Hasselblad lenses make good enlarging lenses. Since the shutter need not be operated, adapting them to the enlarger is very simple. A special mounting plate, called a lens flange, is available. It has a bayonet mount for the lens on one side and is flat on the other side. It is attached to the enlarger's lens board with the flat side resting against the board. The diaphragm is opened and closed manually after depressing the manual stop down control.

Lens cases

Lenses are the most expensive components of a camera system. It therefore makes good sense to keep them absolutely clean and in perfect operating condition. Protect them as much as possible, on and off the camera. There are various items which help to protect them:

Leather cases. The larger and heavier lenses in the Hasselblad line which frequently are not carried in a camera case are supplied in their own leather cases. Each case is different and made specifically for each lens. Unless these lenses are carried in another case, it is recommended to keep them in their leather cases.

Plastic cases. The smaller and lighter Hasselblad lenses when purchased separately are supplied in a plastic container which holds the lens firmly, with a bayonet mount in the bottom.

It is often inconvenient to use these lens cases during shooting, but at least use them for storage and transport. Being plastic, they can break and therefore must be treated with some care. Most Hasselblad agents can supply replacements if necessary.

Lens covers

Lens covers are to keep the lenses clean. Front and rear lens surfaces can be cleaned easily but frequent cleaning can erode the surface. Lens covers help greatly to reduce the need for cleaning. Remember that the rear of the lens is also exposed to dust when it is not on the camera. The rear of a Hasselblad lens needs special protection to maintain and keep clean the pin and shaft of the connecting mechanism.

Keep the front and rear lens caps on all separate lenses even if they are carried in a case. Keep a lens cap on the camera lens, in or out of a case. Keep lens caps readily available when working in sand or dust or near water and keep them on the lenses except during the short time the exposure is made.

It is a good idea to keep the sunshade on the lens when it is carried, or stored in a case. Hasselblad does not make covers to go over the lens shades, but rubber covers to fit over the square shades are available in some countries. To keep dust away from a lens equipped with the professional lens shade, slide a piece of thin cardboard or acetate in the front frame.

If a filter is fitted to a Hasselblad lens that takes Series 50 filters, the regular lens cap can no longer be used. There are two solutions: either use the cover from the plastic filter case as a lens cover, or buy one of the metal lens caps made for the lenses with automatic aperture control. These caps fit on the inside bayonet mount of lenses and filters.

The rules for the protection of lenses naturally apply to anything made from glass, such as viewfinders or filters. Keep all these items in protective covers, cases or pouches whenever possible.

Quick focusing handles

On the shutter lenses, 120 mm and longer, and on all F lenses without shutter, the focusing ring is some distance in front of the camera body and can therefore easily be reached and turned. On the C lenses of shorter focal length, the ring

is close to the camera body and may therefore be difficult to manipulate. Quick focusing handles can help in this situation. These plastic rings have handles that protrude beyond the camera body and therefore allow fast and easy turning. This idea was used in the space program, where the moveable rings on the lenses had grips which allowed the astronauts to operate them with gloves on.

The focusing handle 2 is made for the 120, 150, and 250 mm lenses and is usable on all three SLR models—500C/M, 500EL/M and 2000FC. Handle 1 is usable with the 50, 60, 80, 100 and 105 mm lenses but only on the 500C/M and 500EL/M, not on the 2000FC where the ring interferes with the shutter speed ring. The quick focusing handles are simply pressed over the focusing ring and locked with the set screw in the handle.

Put the rings on the lens so that the handle is in the most convenient position for your use. This depends on how you hold the camera and which focusing distances you use most frequently. Make certain that the handle can rotate conveniently over the focusing range you plan to use and does not interfere with the flash cord.

You can place index markers in different colours on the handles to show various distances which allows you to see a distance setting without looking on the focusing ring. For instance, a red mark can be placed so that it is on the side of the camera when the lens is set at 50 ft. You can then focus from behind the camera by turning the focusing ring until you see the red marker on the side. You can use a second colour for 20 ft and third for 10 ft. The markers are also valuable because the focusing rings partially cover the engravings on the focusing ring.

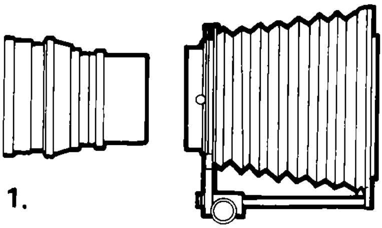
The Professional lens shade is designed as a bellows which can be extended up to 4 in to suit the lens used. It screws directly onto the 50 mm and 60 mm Distagon C lenses and the 38 mm Biogon C lens (**1**). An adaptor ring is available for attaching the shade to other lenses (**2**). On the front of the shade are two slots for holding the gelatin filters (**3** left) and on the back two clamping screws (**3** right). There are a variety of masks (**4**) for the Professional lens shade which indicate the subject area covered by the various lenses. An open L-connector (**5**) is supplied with the Professional lens shade.

The square sunshades can he used for holding the small electronic flash shoe mount or the meter knob mounting attachment (**6**) which can all be slid over the top or sides of the shade when the lever (**7**A and **8**A) is in the up position. Both are locked by pushing the lever back down. The flash units must be connected to the PC contact on the camera or lens. The meter knob is mounted on the shade via the mount in the same way as it is on the camera.

To attach the quick-focusing handle (**10**), loosen knurled locking ring A and press the handle on the focusing mount. Move the handle into a convenient position where it does not interfere with the cable release or flash sync cords. Tighten the locking screw. The small clip-on riders (B) can be shifted around the handle and moved to any desired position (**11**), for example to positions where they indicate specific distance settings or depth-of-field ranges.

12 Square sunshades are the most effective since they correspond to the image format. Most Hasselblad sunshades are of this type. On the 80 to 250 mm C lenses and 80 mm Planar F, the lens shade (S) bayonets on the outside of the lens mount while filters (F), Softars or Proxars attach to the inside bayonet.

13 On the 38, 50 and 60 mm lenses, the filters (F) are positioned at the end of the lens and are held in place with either the lens retaining ring (R) or the lens shade (S).



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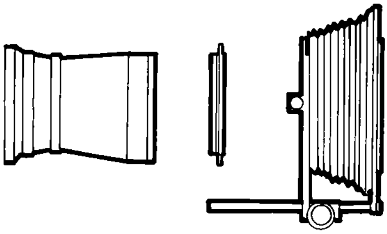

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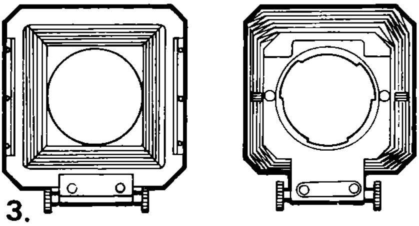

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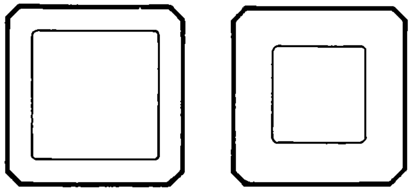

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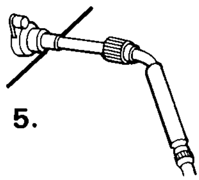

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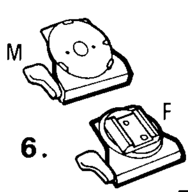

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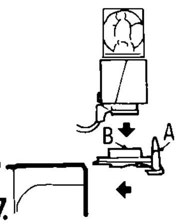

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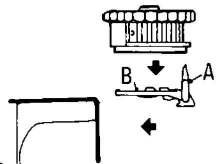

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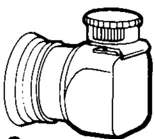

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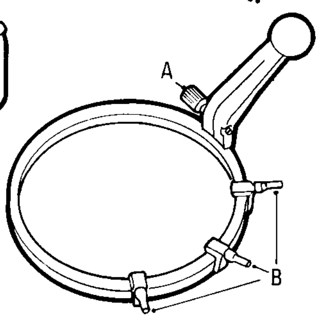

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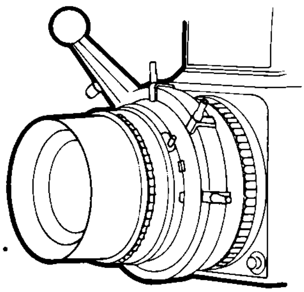

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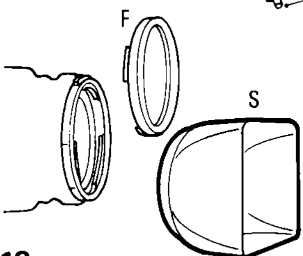

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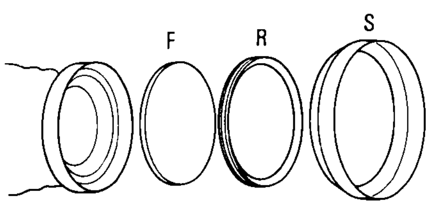


13.

Lens shades

Multicoating of lenses has not reduced or eliminated the need for lens shades. They are still important for maximum contrast, especially when photographing towards light sources, against white backgrounds or bright areas in general (including overcast white skies, water, sand, snow). Square sunshades are most effective as they correspond to the image format. They also allow a small flash unit or the meter knob to be mounted with the available attachments.

Regular square or round shades are compact and provide good shading in most cases. They are not as effective however as the professional lens shade. The bellows can be extended on this to suit the focal length of the lens. The permissible maximum extension is engraved on the rail. The slot at the front of the bellows takes masks to suit longer focal length lenses, or to make vignettes.

The professional lens shade makes an excellent filter holder for inexpensive 75 mm (3 in) square gelatin filters. In the gelatin filter holder, or by themselves, they go in the rear slot on the shade. You can slide the filter partly in or use smaller pieces to filter the required areas only.

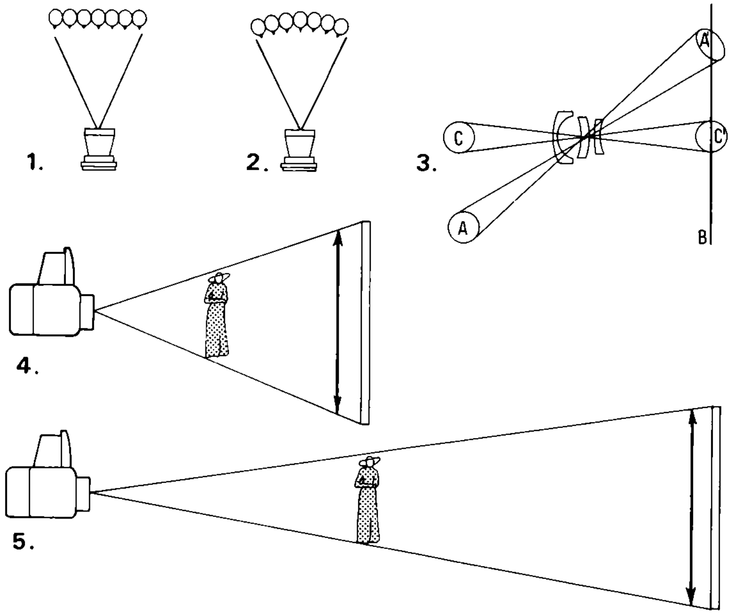
The professional lens shade fits on most lenses. With the 63 mm adapter ring it can be mounted on the 38, 50 and 60 mm lenses and with the 50 mm bayonet adapter it can be mounted on all C lenses from 80 to 250 mm and on the F Planar 80 mm. The bayonet adapter allows the shade to be switched from one lens to another as quickly as another lens shade. With the 63 mm lenses, it is easier to leave the adapter on the lens and change the shade by undoing the two knurled screws rather than removing or attaching both the shade and adapter. If you have more than one 63 mm lens, buy an additional adapter and leave one on each lens.

CREATIVE USE OF LENSES

Wide-angle lenses with their larger angle of view cover larger areas than the standard lenses and subjects are therefore recorded correspondingly smaller. Telephoto lenses have a smaller angle of view and therefore cover smaller areas and magnify subjects. Switching lenses is frequently more convenient than moving the camera closer to or farther away from the subject and often it is the only way of covering a particular area. Lenses, however, can do much more; look at them more as major tools for creating effective, beautiful, unusual and interesting images.

Perspective control

Lenses can be used to change the size relationship between the foreground and background, i.e. perspective. Perspective is determined by the viewpoint,



When three-dimensional subjects are photographed with wide-angle lenses, subjects at the edges (**3**) are seen by the lens from the side—not from the front as those in the center are—and therefore appear distorted (**1, 3**). When photographing groups of people, the distortion can be minimized or eliminated by turning the people at the edges toward the centre (**2**) so that the lens sees them from the front. You could also arrange the group in a slight circle around the lens axis.

By using different lenses you can cover smaller or larger background areas without changing the size of the main subject. A short lens from a short distance (**4**) covers a large background area, a longer lens from the necessarily longer distance (**5**) covers a smaller background area. The size of the main subject is the same with both lenses.

which is the position of our eyes (or the position of the camera lens). Note that it is the *position* of the lens, not the *focal length*, which determines *how much* of the area will be included. How we see and record the subject is determined by the viewpoint, i.e. the distance. Perspective is not only the viewpoint when the picture is taken, but the viewpoint selected when viewing the print or slide, i.e. the perspective in the final image, the photographic print or the transparency is determined by the viewing distance.

Every image, regardless what focal length lens was used, appears in the normal perspective if the viewing angle equals the taking angle. The size of the recorded subject then has the same ratio to the viewing distance as the actual subject had to the camera distance. The correct viewing distance for true perspective can be determined from the following formula:

$$\text{Distance} = F \times M$$

where F is focal length of the lens and M is degree of enlargement of the print or slide. According to this formula, the correct viewing distances for some common print sizes made from $2\frac{1}{4}$ in square negatives are as follows:

'CORRECT' VIEWING DISTANCES

Camera lens	For 5 × 5 in print	mm	For 8 × 8 in print	mm	For 16 × 16 in print	mm	For slide on 5 × 5 ft screen	metres
40 mm	3½	90	6	150	12	300	3½	1.1
50 mm	5	120	7¼	180	15	370	4½	1.3
80 mm	7	180	12	300	24	600	7	2.2
120 mm	11	280	17	440	35	890	11	3.3
150 mm	14	350	22	550	43	1100	13	4
250 mm	23	580	37	920	73	1850	22	6.8
500 mm	46	1160	74	1840	146	3700	44	13.6

The above figures apply when the full negative is enlarged. If only a portion from the negative is used, the magnification is higher and the viewing distance must be correspondingly longer.

Selective backgrounds

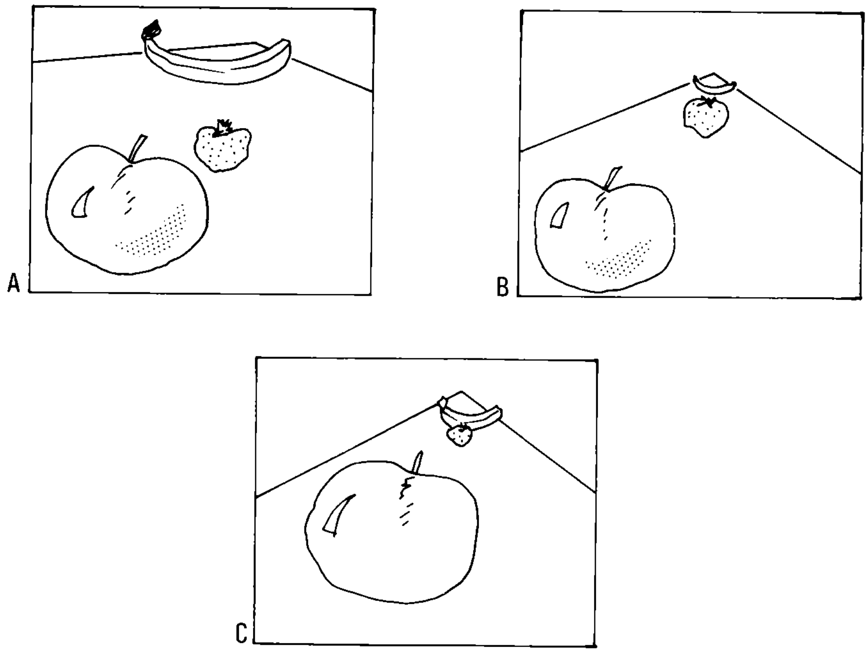
Different focal length lenses can also be used to change the background area without changing the size of the foreground subject. Long lenses permit us to cut down background areas, eliminate distracting background elements, billboards, cars, people or direct light sources. They are valuable in the studio as the longer lenses allow smaller paper backdrops to be used. In a formal outdoor wedding picture, the longer lenses may be preferable as they produce a small, blurred undisturbing background. In a candid shot, however, a large background may be desirable to identify a location.

If the backgrounds are beyond the depth of field, and therefore unsharp, the focal length of the lens determines the degree of unsharpness. As longer lenses magnify backgrounds, they also magnify the blur. Such backgrounds, therefore, are less sharp. By using a short focal length lens, your backgrounds may be just slightly out of focus.

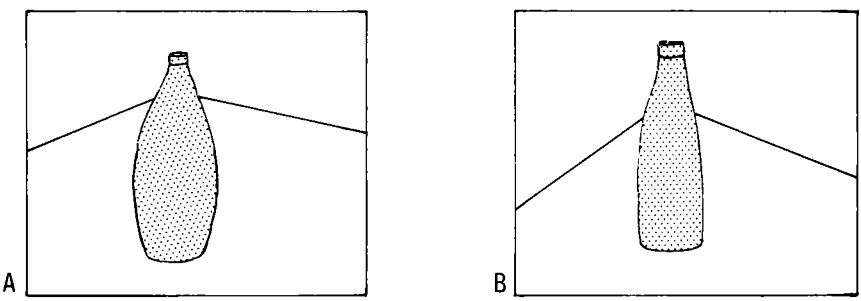
At the same diaphragm opening, but with a longer focal length lens, you can have backgrounds completely blurred, forming a subdued, undisturbing backdrop behind the main subject.

Foreground sharpness

What has been said about background sharpness applies also to subjects closer to the camera. The focal length of the lens determines whether foregrounds are sharp or become a patch of diffused colours. The 'blurred foreground' approach usually works beautifully on colour film but not in black-and-white. The blurred patches can add a touch of colour or can be used to frame the main subject. Suitable objects for blurred foregrounds can be



Distance determines the size relationship between foreground and background, i.e. perspective. When a telephoto lens is used (A) the pieces of fruit appear fairly close to each other. With a standard lens (B), the relative positions are very much as the eye would see them. With a wide-angle lens (C), the more distance objects appear much further away and smaller.



When wide-angle lenses are used close to the subject, the exaggerated perspective may appear as distortion (A). More natural perspective is obtained from a greater distance.

found almost everywhere outdoors but they can also be placed artificially—a tree branch or flowers can be held in front of the lens.

Out-of-focus foregrounds are generally best when blurred completely so that they are not even recognizable, rather than blurred just a little when it might almost look like a mistake. If the standard lens does not provide enough blurr, go to a longer lens.

Correcting verticals

Vertical lines of a building, for instance, appear in the finished picture vertical and parallel to each other only if the camera was level. As soon as cameras are tilted upward or downward, the verticals slant toward each other; the building seems to be falling over. You can often avoid this and obtain 'straight' verticals by changing lenses and camera position.

THE HASSELBLAD LENSES

80 mm f2.8 Planar C. Standard lens for $2\frac{1}{4}$ in square and $4\frac{1}{2} \times 6$ film size.
7 lens elements in 5 components.
Focal length: 80.5 mm.

Position of entrance pupil:	26.6 mm behind the first lens vertex.
Diameter of entrance pupil:	28.8 mm.
Position of principal plane H:	10.8 mm in front of the last lens vertex.

80 mm f2.8 Planar F. Standard lens without shutter but with optical specification same as 80 mm Planar C.

100 mm f3.5 Planar C. Can also be considered a standard lens for the $2\frac{1}{4}$ in square with superior image quality at wide apertures. Recommended when highest corner details and maximum contrast are required. Corrected to provide best quality at long distances. Superb distortion correction makes this lens ideal for architectural work, aerial surveying and mapping.
5 lens elements in 4 components.
Focal length: 100.3 mm.

Position of entrance pupil:	32.9 mm behind the first lens vertex.
Diameter of entrance pupil:	28.7 mm.
Position of principal plane H:	27.1 mm in front of the last lens vertex.

105 mm f4.3 UV Sonnar C. Made from fluorite and quartz elements for light transmission in UV range, for use in scientific and technical applications using short or long range UV radiation. Also usable for general photography in visible light. Excellent distortion correction.
7 lens elements in 7 components.
Focal length 107.2 mm.

Position of entrance pupil:	39.8 mm behind the first lens vertex.

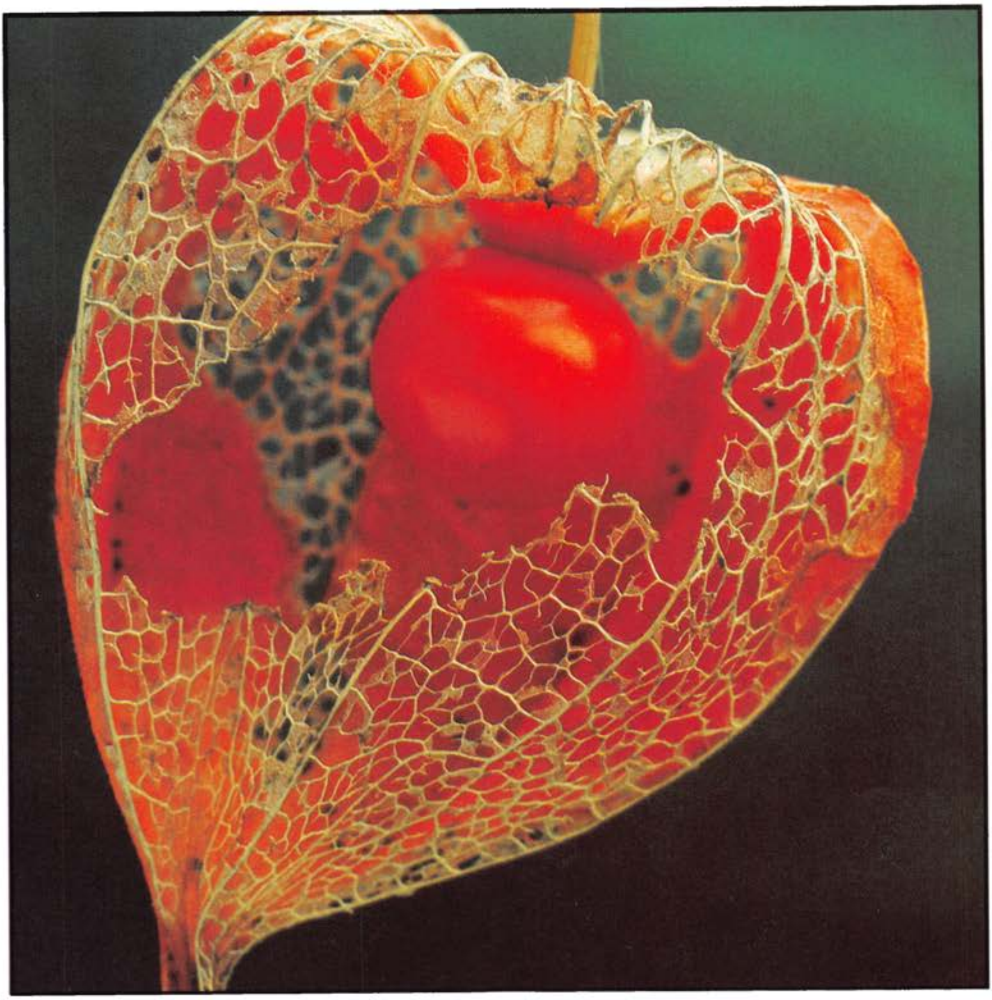
△*Focusing on a moving subject in close up is always difficult. The best method may be to set the lens at minimum focus and follow the subject by moving the camera. Using off-the-camera flash means that the exposure time does not need to change as the subject moves.* Joh. Nautsch.

◁*The 135mm f5.6 S-Planar is designed for use with the bellows extension, giving continuous focusing from 21in (1:1 reproduction) to infinity. The bellows – tripod coupling means the camera-bellows-lens combination can be moved with respect to the subject without moving the tripod.* Joh. Nautsch.

△*Although natural lighting almost always gives the best colour rendition at short lens-to-subject distances, it can be a problem. The Hasselblad ringlight was used for this photograph providing even, shadowless lighting. It can also be used to supplement daylight.* Joh. Nautsch.

◁*Close-up photographs like this one of two mosquitoes mating require great patience and an understanding of the subject's natural behaviour, habitat and vital requirements, as well as familiarity with the camera equipment.*
Choose backgrounds with care. Bertil K. Johanson.

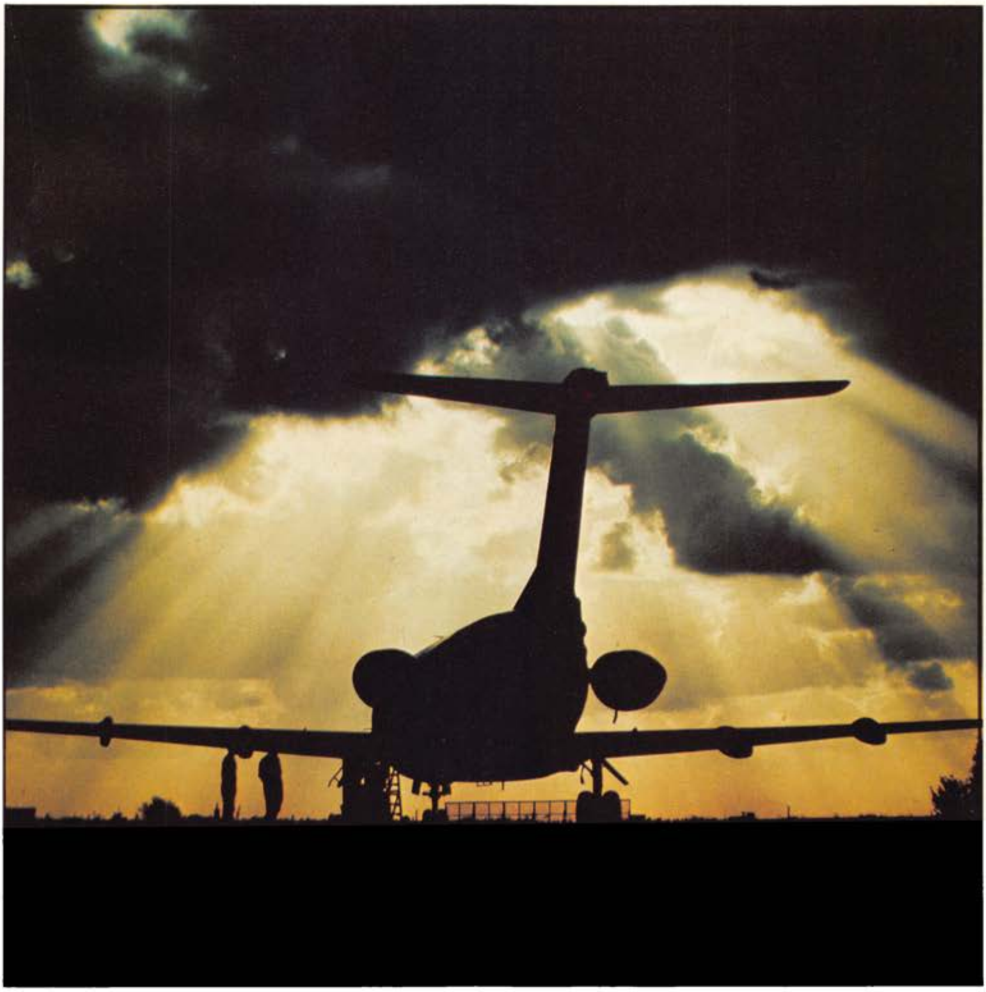
△*Close-up photographs can be taken using ancillary Proxar lenses instead of the extension bellows. They are small and light enough to carry in any equipment bag and require no exposure compensation. Proxar lenses can be combined to increase the scale of reproduction.*
Fridmar Damm.



△Indoors, still life subjects are away from the wind and there need be no subject movement. You can take time in arranging the subject, providing reflectors to concentrate the light and setting up the equipment in the most favourable position.
Klaus Burkhardt.

△Lighting is always a problem in close-up photography particularly outdoors where the wind can cause slight movements. Here, direct sunlight was used to reduce the exposure time. Sheets or tubes of perspex can also be used to shield the subject from the wind. Bo Timback.

△The combination of various image elements and equipment items can make or break a picture. This photograph was taken with a 350mm lens; a 76mm extension allowed the lens to be focused at a shorter range than that provided by the framing ring. Joh. Nautsch.

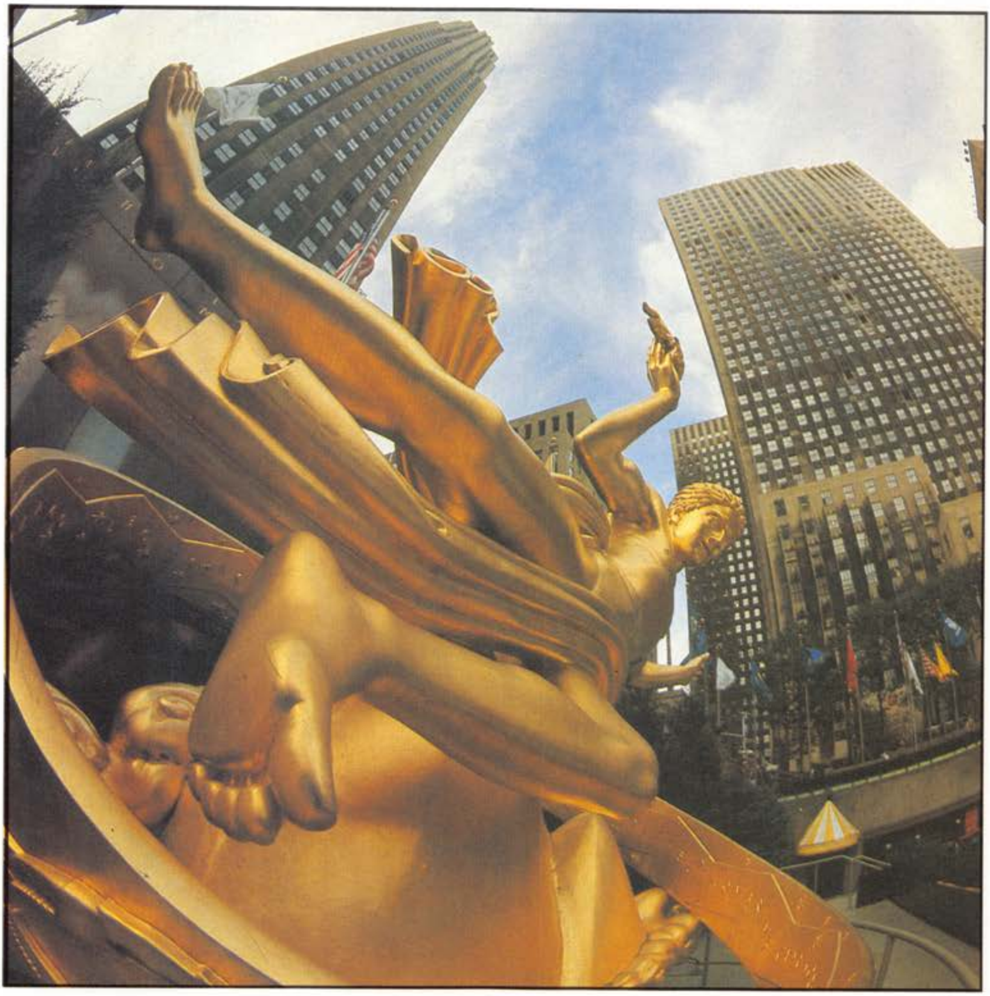


△*With the sophisticated multicoating on T* lenses, pictures can be taken of backlit subjects without the risk of troublesome flare. Although the effect here is a silhouette, multicoating also increases shadow detail in this situation.* VFW-Fokker.

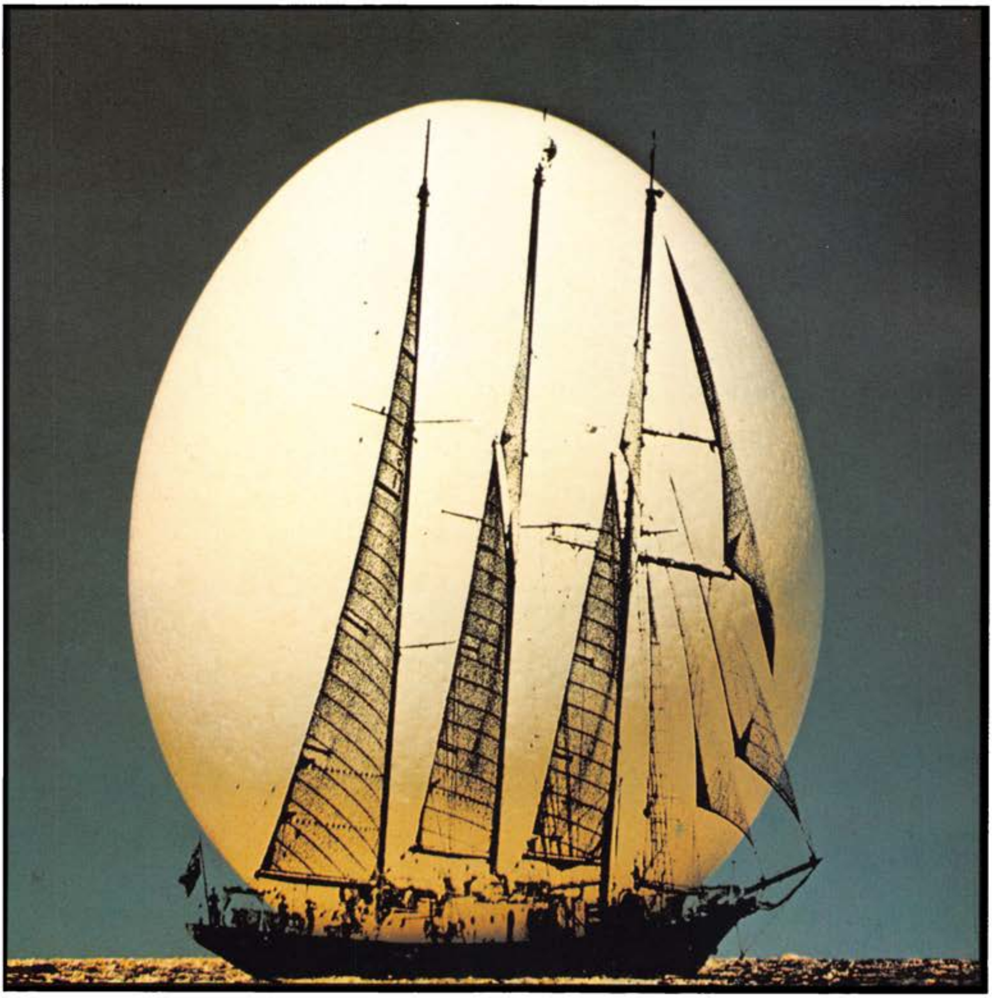
Δ*The 30mm Distagon is an unusual choice for aerial photography, although it does give wide area coverage at low altitude where fogging by air pollution is minimized. The choice of a circular subject has masked the image distortion normally given by fish-eye lenses.* Ulf Carlson.

△This picture was taken from 10m at f8 and 1/125 sec with the Hasselblad 500C and Distagon 50mm wide-angle lens. Movement is relatively slow underwater so exposure times can usually be longer than normal and ancillary lighting at these depths is unnecessary. Bo Brännhage.

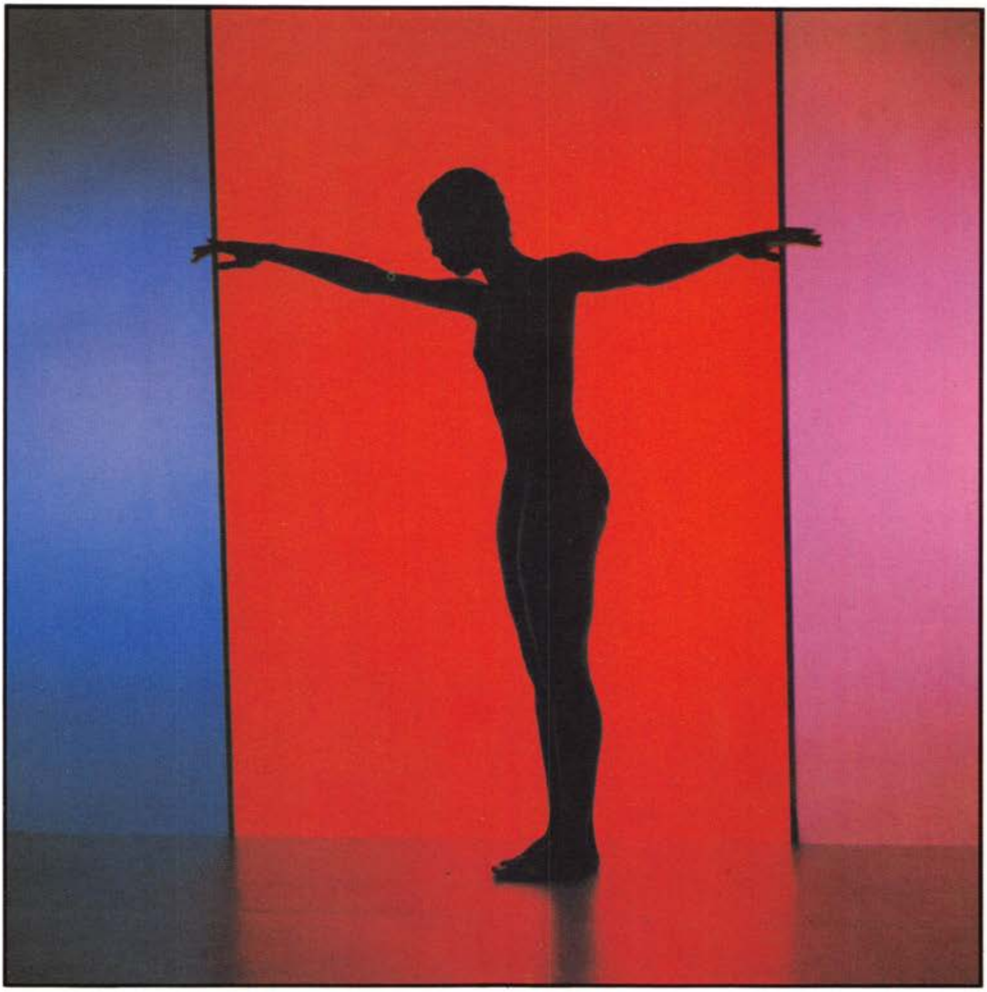
△*The 30mm F-Distagon f3.5 fish eye has the shortest focal length of any lens in the Hasselblad system and an 180° diagonal angle of view. The optical distortion can produce striking photographs although too many viewed together can seem repetitive.* Björn G. Breitholtz.



△*The fish eye, with its extremely short focal length, has the greatest depth of field of any lens. In this photograph, both the statue nearby and the distant tops of the skyscrapers are in focus. Note how the in-built distortion at the edges aids the composition.* Bart Mulder.

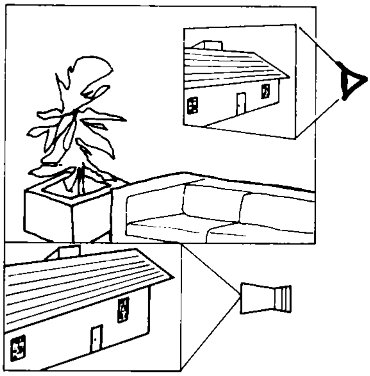


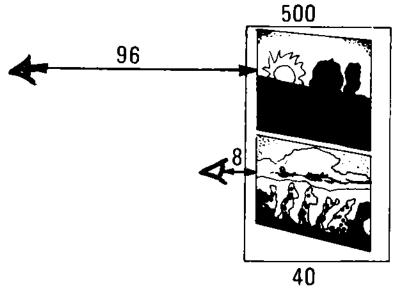
△ *A combination 'sandwich' in which the square format and colouring enhance the effectiveness of the final image. In a rectangular format against a light background, the shape and modelling of the egg would have lost impact.* Ulf Sjöstedt.

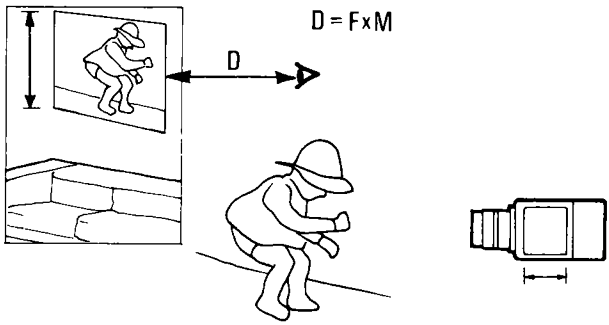


△Silhouettes nearly always make effective images but the choice of background is almost equally important. Note here how the structure of the background carries the small subject and the choice of colour balances the stark outline of the central image. Ernst Wildi.

△*Sandwiching pictures to make one allows freedom in composition and scope for adjustment. The composite may be made either by projecting or printing two or more transparencies together or by printing parts of negatives onto one sheet of paper.* Gerolf Kalt.







Every photographic image is seen in the right perspective when the viewing angle corresponds to the angle under which the image was photographed (top left). This would mean that an 8 × 10 in print taken with a 500 mm lens would have to be viewed from 96 in (8 feet, 2.5 m) (top right). To see correctly the same size print but made with a 40 mm wide-angle lens the eye must be down to 8 in (20 cm). The proper viewing distance, D, can be determined by multiplying the focal length of the lens (F) by the number of times the negative or transparency was enlarged (M), i.e. D = F × M.

With the same formula it is possible to determine the focal length of the lens necessary to record a subject so that it appears in proper perspective when enlarged to a certain size. By juggling the above equation, we get F = D – M. For example, for a 16 × 16 in image viewed from 36 in, M = 16 – 2¼ = 7.1 and F = 36 – 7.1 = 5 in; a 120 mm lens should therefore be used.

Diameter of entrance pupil:	24.6 mm.
Position of principal plane H:	26.8 mm in front of the last lens vertex.

110 mm f2 Planar F. Large aperture lens without shutter, focal length somewhat longer than standard making it ideal for stage, sports, press applications.
7 lens elements in 6 components.
Focal length: 108 mm.

Position of entrance pupil:	55.2 mm behind the first lens vertex.
Diameter of entrance pupil:	53.8 mm.
Position of principal plane H:	33.4 in front of last lens vertex.

120 mm f5.6 S-Planar C. The designation S indicates that the lens has the best image correction at close distance and is therefore especially recommended when maximum corner-to-corner quality is necessary in close-up work especially when photographing flat copy, where contrast is also necessary. Although best correction is at close range, the Planar S is an equally good lens for long distance photography and for portraits. The distance ring is engraved with a magnification scale. The lens should not be used with Proxar lenses; for close-up photography use extension tubes or bellows extension. The 120 mm Planar is frequently considered instead of 150 mm Sonnar if the smaller aperture is acceptable.
6 lens elements in 4 components.
Focal length: 121.0 mm.

Position of entrance pupil:	39.4 mm behind the first lens vertex.
Diameter of entrance pupil:	21.6 mm.
Position of principal plane H:	40.1 mm in front of the last lens vertex.

135 mm f5.6 S-Planar C. Lens without focusing mount specially designed for use with bellows extension, when it can be used from infinity down to 1:1 magnification. There is no focusing ring. Maximum correction is at close distances and it is therefore recommended especially for close-up photography. Good correction at long distances makes it a good all-round lens if working with bellows is acceptable. It can also be used with 21, 32 and 55 mm extension tubes but without fine focusing capability.
7 lens elements in 5 components.
Focal length: 137.1 mm.

Position of entrance pupil:	47.4 mm behind the first lens vertex.
Diameter of entrance pupil:	24.2 mm.
Position of principal plane H:	23.5 mm in front of the last lens vertex.

150 mm f4 Sonnar C. Long focal length lens of the compact Sonnar design. Excellent corner to corner quality and illumination. Excellent focal length for portraiture.
5 lens elements in 3 components.
Focal length: 151.2 mm.

Position of entrance pupil:	63.8 mm behind the first lens vertex.
Diameter of entrance pupil:	37.4 mm.
Position of principal plane H:	70.8 mm in front of the last lens vertex.

150 mm f2.8 Sonnar F. Long focal length lens of compact design without shutter. Short distance between film plane and exit pupil (30% shorter than focal length) eliminates vignetting of corner light rays thereby producing exceptional corner illumination on the film and on the ground glass.

5 lens elements in 4 components.
Focal length: 151.1 mm.

Position of entrance pupil:	58.9 mm behind the first lens vertex.
Diameter of entrance pupil:	52.5 mm.
Position of principal plane H:	79.7 mm in front of the last lens vertex.

250 mm f5.6 Sonnar C. Telephoto lens, with the physical length of the lens considerably shorter than focal length. Provides maximum image quality at its largest *f*5.6 aperture. Compact design allows convenient hand-held photography.
4 lens elements in 3 groups.
Focal length: 248.4 mm.

Position of entrance pupil:	125.5 mm behind the first lens vertex.
Diameter of entrance pupil:	44.8 mm.
Position of principal plane H:	23.0 mm in front of the first lens vertex.

250 mm f4 Tele-Tessar F. An optically true telephoto lens with a physical length shorter than true actual focal length of exceptionally wide aperture for a lens of this focal length. It is of five element construction and accepts Hasselblad series 70 filters.

250 mm f5.6 Sonnar Superachromat C. Lens with superb chromatic correction for all colours in the visible spectrum and the infra-red range up to 1000 nm. Ideal for all scientific work, colour separations or all general photography where maximum detail is required, especially when working with the long wave lengths (red).
6 lens elements in 6 components.
Focal length: 249.6 mm.

Position of entrance pupil:	130.5 mm behind the first lens vertex.
Diameter of entrance pupil:	44.6 mm.
Position of principal plane H:	27.9 mm in front of the first lens vertex.

350 mm f5.6 Tele-Tessar C. An optically true telephoto lens of extremely light weight and compact design, approximately 125 mm or 5″ shorter than focal length.
4 lens elements in 4 components.
Focal length: 341.2 mm.

Position of entrance pupil:	325.5 mm behind the first lens vertex.
Diameter of entrance pupil:	59.4 mm.
Position of principal plane H:	47.5 mm in front of the first lens vertex.

500 mm f8 Tele-Tessar C. An optically true telephoto lens with physical length approximately 180 mm or 7 in shorter than focal length. Ideal for long distance work even with hand-held cameras.

5 lens elements in 3 components.
Focal length: 500.1 mm.

Position of entrance pupil:	477 mm behind the first lens vertex.
Diameter of entrance pupil:	62.5 mm.
Position of principal plane H:	125.5 mm in front of the first lens vertex.

60 mm f5.6 Biogon C. An optically true wide-angle lens originally designed for the Hasselblad data camera used in the Apollo space program. The rear of the lens goes deep into camera body and can therefore be used only on the MK 70 photogrametric camera. The lens is also corrected to provide maximum sharpness in combination with the 4 mm thick reseau plate at the rear of the camera. The lens is specially calibrated for the MK 70 camera on which it is used.
8 lens elements in 5 components.
Focal length: 61.1 mm.

Position of entrance pupil:	39.1 mm behind the first lens vertex.
Diameter of entrance pupil:	10.9 mm.
Position of principal plane H:	61.1 mm in front of the last surface of the reseau plate.

60 mm f3.5 Distagon C. An extremely compact wide angle lens of the retrofocus type. Although it is considered a wide angle, many photographers have selected the 60 mm Distagon as their standard lens.
7 lens elements in 7 components.
Focal length: 60.2 mm.

Position of entrance pupil:	32.2 mm behind the first lens vertex.
Diameter of entrance pupil:	17.0 mm.
Position of principal plane H:	11.0 mm behind the last lens vertex.

50 mm f4 Distagon C. Retrofocus-type wide-angle lens with excellent image correction at longer distances. Aperture should be closed down somewhat when maximum quality is needed at closer distances.
7 lens elements in 7 components.
Focal length: 51.3 mm.

Position of entrance pupil:	32.3 mm behind the first lens vertex.
Diameter of entrance pupil:	12.8 mm.
Position of principal plane H:	18.6 mm behind the last lens vertex.

50 mm f2.8 Distagon F. Large-aperture wide-angle lens without shutter. Retrofocus design with floating lens elements. This optical design where lens components change position in relation to each other while focusing maintains excellent image quality in close-up photography.
9 lens elements in 8 components.
Focal length: 51.7 mm.

Position of entrance pupil:	39.2 mm behind the first lens vertex.
Diameter of entrance pupil:	18.2 mm.
Position of principal plane H:	18.1 mm behind the last lens vertex.

40 mm f4 Distagon C. Extreme wide-angle lens of retrofocus design. 'Normal' focusing range down to 0.9 m, close focusing range 0.9 m–0.5 m, with a lock at the 0.9 m position to remind the photographer that aperture must be closed down somewhat to maintain maximum quality in the close-focusing range. The 40 mm Distagon enables the photographer to do extreme wide angle photography while maintaining the single-lens reflex concept and the advantages of viewing the image on ground-glass screen.
10 lens elements in 9 components.
Focal length: 40.9 mm.

Position of entrance pupil:	45.5 mm behind the first lens vertex.
Diameter of entrance pupil:	10.2 mm.
Position of principal plane H:	28.7 mm behind the last lens vertex.

38 mm f4.5 Biogon. An optically true wide-angle lens for the Superwide camera where distance from front of camera to filmplane (34.5 mm) is shorter than focal length of lens. Superb corner-to-corner sharpness wide open and for practical purposes completely free of distortion at all distances down to 0.3 m. The Superwide camera is frequently preferred for extreme wide-angle photography because of its extremely compact design and light weight.
8 lens elements in 5 components.
Focal length: 38.5 mm.
Min. focusing distance: 0.3 m (12″).
Min. aperture: *f*22.

Position of entrance pupil:	21.7 mm behind the first lens vertex.
Diameter of entrance pupil:	8.6 mm.
Position of principal plane H:	19.9 mm in front of the last lens vertex.

30 mm f3.5 Distagon F. A fish-eye lens covering the entire $2\frac{1}{4}$ square field from corner to corner with practically no light or quality fall off. It has a 180° diagonal image field.
8 lens elements in 7 components.
Focal length: 30.6 mm.

Position of entrance pupil:	28.5 mm behind the first lens vertex.
Diameter of entrance pupil:	8.5 mm.
Position of exit pupil:	35.9 mm in front of the last lens vertex.
Position of principal plane H:	40.2 mm behind last lens vertex.

140–280 mm f5.6 Variogon C. A zoom lens designed by Schneider in which the image stays in focus while zooming and aperture remains unchanged throughout the entire zoom range. Normal focusing range at all focal length from infinity to 2.5 m (8.2 ft). Macro focusing at 140 mm focal length down to 1 m (3.5 ft).
17 lens elements in 14 groups.
Minimum aperture: *f*4.5.

140–280 mm f5.6 Variogon F. A zoom lens as above but without shutter.

14

Filters

There are five basic reasons for using filters: to obtain 'correct' colour rendition on colour film or 'correct' grey tones on black-and-white film; to enhance colour images or change grey tones in black-and-white; to create special effects and moods; to reduce the amount of light reaching the film; and, to protect the lens.

Filters as lens protection

To start with the last point, lenses are the most expensive components in the Hasselblad camera system. They are also the components that are most easily damaged and are probably the most expensive to repair. The simple way to protect the front element is with an optically plain piece of glass, which is easy to clean and relatively cheap to replace. The logical choice is a sky-light, UV or haze filter. These do not change the colours or grey tones to any noticeable degree and, by reducing the UV rays, frequently provide a slight improvement or a slight warming-up in outdoor images.

To maintain the lens quality, all filters must be made to the same degree of perfection as the lens. Each lens should be equipped with a filter which then becomes a somewhat permanent feature of each lens. It is too time consuming to switch filters from one lens to another every time lenses are changed. For colour photography, it is best to use identical filters made by the same company on every lens to avoid possible slight differences in colour rendition. A sunshade over the lens is essential when you use a filter, and is a further protection against possible mechanical damage. It also prevents snow or raindrops from falling on the lens element and creating a 'diffusion' effect. This is especially true for the professional lens shade as it can be extended quite a distance in front of the lens.

Neutral density filters

Neutral density filters, also called grey filters, are used in both black-and-white and colour photography. Made from neutral grey-coloured glass, their purpose is to reduce the amount of light reaching the film without changing the tonal rendition of the various colours. Neutral density filters come in different densities requiring the following compensating increases in exposure:

Density	Percentage light transmission	Increase in exposure in Exposure Values or *f* stops
0.3	50	1
0.6	25	2
0.9	12	3
1.2	6	4
1.5	3	5
1.7	1.5	6

Hasselblad neutral density filters have the following specifications:

4×	Gr-2	Density 0.6	Increase in exposure 2 EV
8×	Gr-3	Density 0.8	Increase in exposure 3 EV
64×	Gr-6	Density 1.8	Increase in exposure 6 EV

Neutral density filters can be combined. The increase in exposure is obtained by adding up the densities, for example the 0.3 and 0.6 filters combined have a density of 0.9.

Neutral density filters can be used when high speed films are used outdoors, for example, when the sunlight is too bright to permit photography at large apertures with shallow depths of field or at the slow shutter speeds necessary for blurred motion or zoom effects. Neutral density filters can also be used to compensate for different film sensitivities. The most valuable application in practical photography is when Polaroid material is used for test shots; the filters allow the same aperture and shutter speed to be used for both the final image and the test shot.

In black-and-white photography, colour filters such as yellow, green, orange or red can frequently be used instead of the neutral density type, as the change in the grey tones may not be objectionable and even beneficial.

Filters for black-and-white photography

In black-and-white photography, the various colours are recorded in a range of grey tones from white to black. Exactly how they are recorded depends on the type of film and light. Panchromatic films are sensitive to all colours and record subjects in a range of grey tones pretty much as we visualize them. There are, however, still cases where filters can improve the black-and-white images.

For example panchromatic films are still somewhat more sensitive to blue and therefore record blue lighter than we visualize it. A yellow-green filter corrects this and is recommended for outdoor scenes with blue skies.

A green filter lightens green somewhat beautifying outdoor scenes with green fields and trees. It also produces good flesh tones in outdoor portraiture.

In tungsten light, red and green appear as the same grey tone; red, orange and yellow appear lighter; and, skin tones and lips therefore somewhat pale. This can be improved with a blue (B-12) filter.

The main application of filters in black-and-white photography, however, is not for recording subjects in 'natural' grey tones but for purposely darkening or lightening certain colours to emphasize, suppress, separate, increase or reduce contrasts. You can lighten or darken any colour: the colour of the filter determines what happens to what colour; the degree of colour change is determined by the density of the filter.

To lighten a colour, use a filter of the same colour, or at least from the same side of the colour wheel.

To darken a colour select the colour directly across the wheel, or at least from the opposite side.

A yellow filter darkens colours from blue-green to violet or red. Green filters lighten green and darken purple and red. They can be used to lighten shaded green areas under trees. An orange filter darkens colours from green to violet and lightens colours from purple to yellow-green.

Combining filters

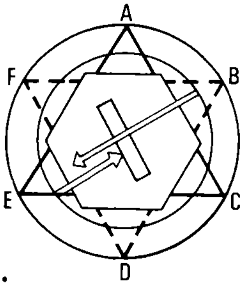
When colour filters are combined with neutral density and polarizing filters, the effect of both shows up on the film: the neutral density filter decreases the light reaching the film and the colour filter changes the grey tones.

Two strong filters of the same colour, for instance two orange or two red filters, produce in black-and-white the same result as one filter. The explanation is simple. If one red filter already absorbs all the blue and green, a second red filter can not do any more. It transmits less of the warm colours, and requires a larger increase in exposure without altering the image. It makes even less sense to combine strong filters of completely different, complementary colours, such as an orange filter and a blue filter. The blue filter absorbs all or most colours at one end of the spectrum, the orange filter those at the other end, so little is left to form an image.

Combining two similarly coloured pale filters, though, does double the effect in colour or black-and-white.

Exposure increase

A filter absorbs light. With light-coloured filters (UV, haze, and some light-balance and colour-compensating types) the light loss is so small that it need



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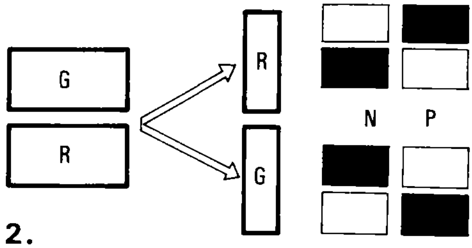

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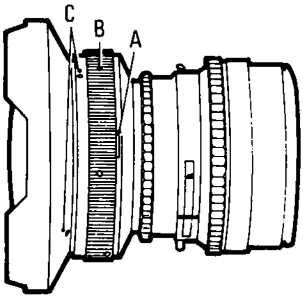

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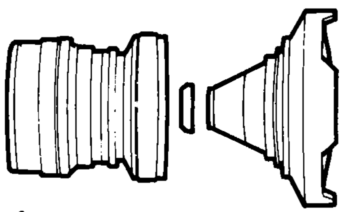
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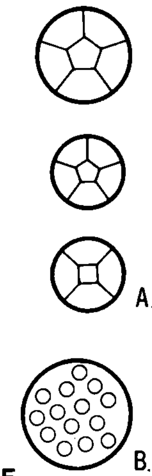

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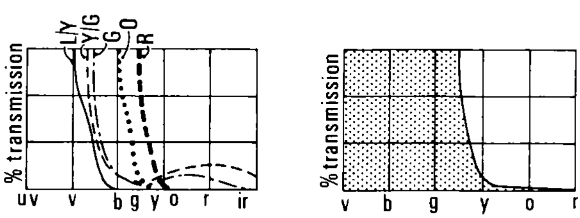


6.

The colour wheel (1) is a convenient tool for determining how various colours are reproduced in black-and-white through different filters. A filter transmits light of its own and close colours and absorbs light of colours on the opposite side of the wheel. The positions of the colours are: red, A; yellow, B; green, C; cyan, D; blue, E; and, magenta, F. For example (2), green light will be absorbed by a red filter, giving a light image on the negative (N) and a dark image on the print (P); red light gives a dark image on the negative and a light image on the print. The situation is reversed when a green filter is used.

3 To attach or change a filter on the 30 mm Distagon, press the release (A) and turn the knurled ring (B) counter-clockwise until the two red dots (C) are opposite each other. Lift the front section and screw the filter to the end of the cone. The lens is assembled (4) by placing the front section in the rear part with the two red dots opposite each other and turning the knurled ring clockwise. To reduce the possibility of attaching the front section without the glass or filter, the rear ring of the lens is painted in bright red; it should not be visible when the sections are assembled.

The multiprisms (5A) consist of a central field and four or five marginal sectors and produce multiple images without the need for multiple exposures. They are mounted in front of the lens and do not require an exposure increase. The diffusion effect of Softars (5B) is produced by a great number of tiny lens elements evenly distributed over the entire surface.

6 The absorption curves for Hasselblad filters (left) show the extent to which each colour is absorbed and transmitted. The colours are: ultra-violet, uv; violet, v; blue, b; green, g; yellow, y; orange, o; red, r; and infra-red, ir. The curves published by other manufacturers (right) give similar information.

not be considered for exposure determination. Darker filters on the other hand take away a sufficient amount of light to affect exposure. As a result, lens settings must be adjusted. With the Hasselblad meter prism, the light is measured through the filter, and the light loss is automatically compensated for. The meter readings are therefore correct for most filters. When light is measured with a separate meter, such as the Hasselblad meter knob, an adjustment must be made based on the information from the filter manufacturer.

Some companies give the necessary increases in filter factors, others in apertures. It is most important that we know which figure is on the chart as they are two different things. Simply multiply the shutter speed by the filter factor, or alter the *f* stop or EV setting by the aperture increase. For example, with a 4 × (or +2 stop) filter, change from EV 13 to EV 11.

FILTER FACTORS AND *f* STOPS/EV

Filter factor	1.5	2	2.5	4	6	8	16	32	64
Increase in exposure in *f* stops or EV	½	1	1½	2	2½	3	4	5	6

There is still one other way in which you can compensate, especially if you use one filter most of the time. Divide the filter factor into the ASA rating of film. For example, with an ASA rating of 200 and a filter factor of 8, the calculation is 200 ÷ 8 = 25, i.e. the film sensitivity with the filter is 25 ASA. Set the meter at 25 ASA and use the meter reading directly.

Filter engravings

All the data the photographer needs to know are engraved on all Hasselblad filters. The 26 black-and-white filters are engraved with the filter factor, the colour of the filter, the wavelength limit and the increase in exposure values. For example, 3 × Or 57 – 1.5 is an orange filter with a wavelength limit of 570 nm, a 3 × filter factor requiring an exposure increase of 1½ EV (or *f* stops).

All other filters are engraved with the filter size, the filter factor, the colour and exposure increase in EV. For example, a filter marked 63 2 × YG – 1 has a size of 63 mm, a colour of yellow-green, and a filter factor of 2 requiring an exposure increase of 1 EV value (or 1 *f* stop).

Filter colours are designated as follows: Y = yellow; YG = yellow-green; G = green; O = orange; and, R = red.

Haze penetration: haze, UV and skylight filters

Haze and UV filters do not change colours to a noticeable degree. They do absorb ultraviolet rays and are recommended for photography at high

altitudes or other places where a large amount of UV light exists. Most modern lenses, however, absorb UV light to a great extent, so that 'haze' or UV filters do not increase the haze penetration and consequently do not improve distant shots.

The best improvement in distant shots on colour film is obtained with polarizing filters. They may not penetrate haze but, by eliminating reflections in the distance and in the air, they increase the contrast. Since polarizing filters do not change the colour, distant mountains may still appear somewhat blue. For a warmer rendition add an CR 1.5 or CR 3 (81A or 81B) filter to the polarizer.

In black-and-white photography a yellow filter produces some improvement in distant shots but orange and red filters are more effective. Complete or almost complete haze penetration can be obtained with a red filter combined with infra-red film but other colours are also changed, for instance green appears as white.

Colour quality of light

Colour transparency films are manufactured for a specific colour of light source and correct colour can be obtained only if the colour of the light matches that for which the film is balanced. The colour quality of light is expressed as colour temperature either in Kelvin or in decamired values. Kelvin and decamired values are directly related by the formula:

$$\text{DM value} = \frac{100\,000}{\text{Kelvin value}}$$

COLOUR TEMPERATURE OF TYPICAL LIGHT SOURCES

DM	Kelvin	Type of light
8	12 500	Shade with clear blue sky
16	6250	Overcast day
17	5900	Electronic flash
18	5600	Sunlight at noon
29	3450	Photofloods
31	3200	Tungsten lamps
34	2900	100–200W household lamps
36	2800	40–75W household lamps
54	1850	Candlelight

The colour films used in medium-format photography are matched to the following colour temperature values:

Daylight type:	18 DM	5600 K
Type B:	31 DM	3200 K

Some light sources, such as sunlight at noon, photographic studio lights and electronic flash, have known values as shown on the chart; they do not change

appreciably and actual measurement of the colour temperature is not necessary. Other light sources, such as daylight early in the morning, late in the afternoon, or on overcast days, do not have an exactly known value. The light colour can change within a few minutes without us being aware. Guessing is not good enough when you want an exact match. The colour temperature must be measured with a colour temperature meter.

Colour temperature meters

Colour temperature meters are held in front of the subject and measure the light falling on it. They read out in degrees Kelvin or decamireds so that you can select the filter you need for your film. The simpler meters only measure the red/blue values, but are satisfactory for tungsten and daylight. For measuring fluorescent lights, unusual light sources or light reflected off coloured surfaces, the more expensive three-point meters that also measure green are necessary.

Light balance and conversion filters

Light balance and conversion filters are used in colour photography for matching the colour quality of the illumination to that of the film or to purposely obtain a warmer or cooler colour rendition in the images. Light balance filters are used for minor adjustments, conversion filters for a more drastic change.

The filters which have a warming effect are the decamired red (R,CR) types, the 81 series light balance and 85 conversion types; those with cooling effects are the decamired blue (B,CB) types, or the 82 series light balance and 80 conversion filters. The warming filters are used when the light is too blue for the film in the camera, the cooling filters when the light is too red.

In the Wratten filter series, the necessary filter can be determined only by a colour-temperature meter or from a chart. There is no direct relationship between the colour temperature of the light and the filter value. Also, a filter of a given value can effect a completely different change when the light is in the 3000 K range to when the light is in the 5000 K range. The Wratten filters necessary for the most common filter and light combinations are found in the chart below.

The decamired filter system

The decamired system, also referred to as the photometric system, can simplify the use of light balance and conversion filters. The required filter must always have a decamired value that is equal to the difference in the decamired values of the film and light source. For example, if the film is balanced for DM 31 and the light is DM 28, you need a decamired filter with a +3 DM value ($31-28=3$), which is a red filter (R3).

The Hasselblad decamired filters consist of 4 red filters (CR 1.5, CR 3, CR 6 and CR 12) and 4 blue filters (CB 1.5, CB 3, CB 6 and CB 12).

Various decamired filter values are obtained by combining filters of the same colour, for example a red 10.5 value is obtained by combining a Red 6, Red 3 and Red 1.5. With one set of decamired filters you are able to match any light/film combination. Blue and red decamired filters are, however, not combined.

With light sources of known and fixed colour values, colour temperature meters are not necessary as the correct filter can be determined from the following chart.

FILTER VALUES REQUIRED IN VARIOUS CONDITIONS

Purpose	Decamired filters	Wratten filters
For a warmer rendition with some electronic flash units (some units produce a bluish light)	R 1.5	81A
Outdoor portraits in the shade (under a blue sky)	R 3	81B
On overcast days, in fog as a substitute for skylight filter	R 1.5 or R 3	81A or 81B
To reduce warm tones in early morning and late afternoon photography	B 3	82B
To use type A colour film in daylight	R 12	85
To use type B colour film in daylight	R 13.5	85B
To use daylight film with 3200 K light	B 13.5	80A
To use daylight film with 3400 K light	B 12	80B
To use type B film with 3400 K light	R 1.5	81A
To use type A film with 3200 K light	B 1.5	82A
With flash cubes on daylight film	B 1.5	82A
When using type B film with household lamps	B 3	82C

Exposure increase with filters

When light is measured with a separate meter, the necessary increase in exposure is engraved on the rim of Hasselblad decamired filters. For example, 1.4 × CB 3–0.5 means that the filter factor is 1.4 and the increase in exposure is half an EV. Film manufacturers usually indicate the loss of light caused by conversion filters by a lowering of the ASA rating. For example, a tungsten film rated at 125 ASA in tungsten light is shown as an 80 ASA film when used in daylight with an R 12 (85) conversion filter. The film sensitivity has not really changed, but the sensitivity is lower in daylight simply because of the light absorbed by the filter. Do not compensate for the light loss twice by setting the meter on 80 ASA and also increasing the exposure by the factor shown on the filter.

When using a separate meter, either set the meter on 125 ASA and open the lens by the figure engraved on the filter, or set the meter at 80 ASA and use

the setting on the meter without adjustment. The Hasselblad meter prism must always be set on the film sensitivity for the *original* light source, i.e. at 125 ASA in the above example.

RECOMMENDED EXPOSURE INCREASES WITH HASSELBLAD DECAMIRED FILTERS

Filter	*f* stop EV value	Filter	*f* stop EV value
CR 1.5	0	CB 1.5	0
CR 3	0	CB 3	½
CR 4.5	½	CB 4.5	1
CR 6	½	CB 6	1
CR 7.5	½	CB 7.5	1½
CR 9	1	CB 9	1½
CR 12	1	CB 12	1½

Colour-compensating filters

Colour-compensating filters (CC filters) are used for changes in the overall colour balance or for fine colour corrections. They are available in six colours (yellow, magenta, cyan, red, green and blue) and in different densities in each colour, from about .05 to .50. These filters are most readily available in gelatin. One of their main applications is to compensate for variations in the colour balance of professional films. The required filter is indicated in the film's instruction sheet. The filter matches colours even if the film emulsions come from different batches. Some other applications are when photographing through tinted windows, in underwater photography to compensate for the loss of red, and when photographing under fluorescent lights.

Fluorescent lights

Unlike sunlight or that from other incandescent sources, the light from a fluorescent tube is nowhere near evenly distributed through the spectrum, so the results with colour film can be unpredictable (except with special colour-matching tubes). Film and fluorescent tube manufacturers publish charts showing which colour-compensating filters produce the most satisfactory results.

Instead of combinations of colour-compensating filters, which are not always readily available, some simpler solutions exist. For example, with daylight fluorescent tubes, some of the new high-speed daylight colour films produce fairly acceptable results without a filter. Also, with colour negative films, some correction can be made at the printing stage. Special filters for

fluorescent lights are also available, usually one filter for daylight film, another for type B. These are acceptable with some fluorescent tubes.

There are a few other problems associated with fluorescent tubes which we must be aware of. The tubes vary somewhat between different manufacturers and their colour changes with age and with voltage fluctuations. The colour also changes during the warming-up period, and tubes should therefore be turned on at least 10 minutes before shooting time. Fluorescent tubes go on and off almost completely during each AC cycle and the colours again change; the answer is to avoid short shutter speeds (1/125 sec or shorter).

Polarizing filters

Light that reaches our eyes or the camera lens directly is unpolarized, i.e. the light waves vibrate in all directions perpendicular to the light path. If such light reaches glass, water or many other reflecting surfaces at an angle, between 30° and 40°, it becomes polarized, i.e. the consequent light waves vibrate in one direction only. Our eyes cannot see the difference but, with a polarizing filter, we can determine whether light is polarized or unpolarized.

Polarizing filters are made from a material that changes natural into polarized light. The light that enters the polarizing filter vibrates in all directions; when it comes out on the other side, it is polarized and vibrates in one direction only. A second polarizing filter placed behind the first will transmit the polarized light coming from the first filter if their axes of polarization are in the same direction. Turned through 90°, the second filter will absorb the light, so none or very little light is transmitted. We have what is known as cross polarization.

With a polarizing filter in front of the camera lens, the polarized light that reaches the filter is absorbed when the filter is turned 90° to the axis of the polarization; it is transmitted when rotated in the same direction. All the unpolarized light goes through the filter regardless of how the filter is turned.

If the light is not polarized, rotating the polarizing filter does not change anything. Looking through the filter, therefore, is an easy way to determine whether and which light is polarized and which is natural. If the object changes while rotating the filter, the light reflected off that surface is completely or partially polarized; if the object does not change, the light is regular unpolarized light.

As all polarized light in nature is light reflected off something, polarizing filters do nothing else but reduce or eliminate reflections. These can be reflections off virtually any shiny surface except bare metal. The polarizing effect works the same way with reflections on water, on rain-covered streets, wet leaves, grass and so on. By reducing reflections many surfaces appear in deeper colours, so increasing colour saturation.

While reducing or eliminating reflections is very desirable, or necessary, when photographing art works, pictures under glass, glossy photographs, or

store windows for commercial purposes, it can be undesirable as reflections are very natural, for instance on porcelain or silver. Reflections add life and beauty to water surfaces and eliminating them can destroy this and make the subjects dull and uninteresting, so watch the effect on water when using polarizing filters. Also, be careful when using polarizing filters when photographing through car or aeroplane windows or any other objects made from clear plastic as colour rings, similar to Newton rings and caused by internal tension, frequently show up.

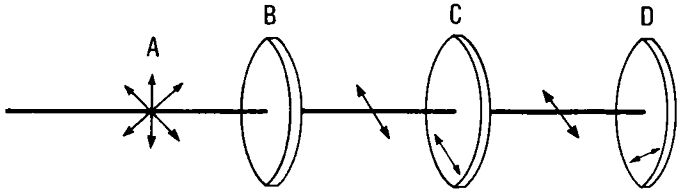
A polarizing filter can also change the appearance of a blue sky since the light coming from the sky has been polarized by passing through the thin layers of the atmosphere. Maximum polarization occurs when photographing at 90° to the direction of a line drawn from the sun to the camera: the filter has no effect when photographing toward or directly away from the sun. Polarizing filters are the only practicable method for darkening blue skies on colour film.

A few technical points about the use of polarizing filters should be mentioned. Polarizing filters are most practical in round form and mounted so they can be rotated easily while viewing the image in the viewfinder.

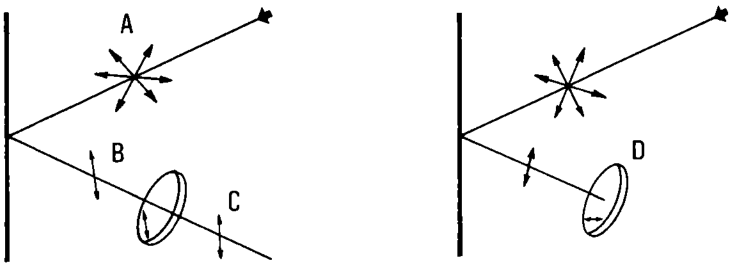
Since polarization depends on the angle of reflection, the effect may not be the same over the entire image area, especially when wide-angle lenses are used. Reflections on a water surface may be eliminated at the bottom of the image, but not at the top; a blue sky may be bluer at the bottom than the top, or bluer on the left side than on the right. Such differences can be seen in the viewfinder, so evaluate the image carefully when using polarizing filters.

Polarizing filters require an increase in exposure because the polarizing material is not clear but has a greyish tint somewhat like a neutral density filter. Hasselblad polarizers demand an extra one EV or *f* stop. The required increase is the same regardless of how the filter is rotated, whether to the position with minimum or maximum polarization. If the polarizing filter eliminates reflections over a large area of the frame, however, the resulting image may appear darker. In such cases another half stop increase in exposure may be better. Some through-the-lens exposure meters including the Hasselblad meter prism use components which partially polarize the light that they measure. So, you cannot rely on the reading through a polarizer. My experience has been that images based on the meter prism reading are overexposed and I suggest closing the aperture one *f* stop more than indicated by the meter, e.g. use EV 12 or *f*/8 when the meter indicates EV 11 or *f*/5.6. An even better method is to take the meter prism reading without the filter on the lens and then close the lens one *f* stop or one EV number for the exposure with the filter.

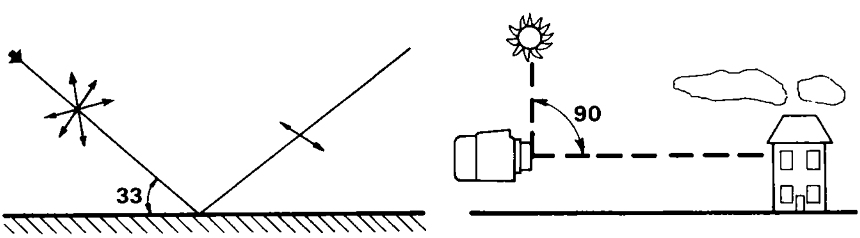
Although polarizing filters look like neutral density filters, they do cause a slight change in colour rendition. The change is visible only when two pictures, taken in the same location with the same light and with and without filter, are compared.



Natural, unpolarized light vibrates in all directions (A). As it passes through a polarizing filter, the light becomes polarized, i.e. it vibrates in one direction only (B). If this polarized light meets another polarizing filter which has its axis of polarization in the same direction as the first, the light is able to pass through (C). A polarizing filter with its axis of polarization at right-angles to the first will absorb all the light (D). This latter arrangement is called cross polarization.



When natural, unpolarized light is reflected by a surface it becomes polarized and vibrates in one direction only. In this state it can pass through a polarizing filter with an axis of polarization in line with the light (left) but not through one at right-angles to this position (right). In the latter case, reflections are eliminated.



Reflected light is polarized only if it hits the surface at a certain angle—between 30° and 40°. Maximum polarization on glass is at 33°, on water at 35°.

Blue skies are darkened by a polarizing filter when pictures are taken at right angles to the sun.

Polarizing filters over light sources

Light from tungsten lights or electronic flash can be polarized by placing a polarizing filter over the light source. A polarizing filter over the lens then eliminates practically all reflections, at all angles, from all materials. This procedure is necessary to eliminate reflections on bare metal. It is also highly recommended when copying.

Filters for infra-red photography

Filters are used in infra-red photography to absorb blue and ultraviolet light so that only the deep red and the infra-red rays reach the film. A filter used for this purpose should absorb wavelengths shorter than about 600 nm.

For scientific purposes, filters absorbing all light below 700 nm are suggested. Two filters recommended for colour work are Kodak # 12 and # 15; the orange in the Hasselblad line is the closest to these. For black-and-white work, a deep red filter is recommended. For experimental and creative work, any filter can be used; yellow, red, green, blue, purple, violet filters produce beautiful and unusual colour effects with many subjects.

Partial filtering

Filters can be positioned in front of the lens so that only part of the image receives filtered light. This may be used to improve an image or to create a special effect. Neutral density filters can be used to darken some areas, colour filters to change colours in some areas, whilst other areas are unfiltered.

Filters which are clear over half of their area and neutral grey or coloured over the other half are readily available. They produce the proper effect, but the dividing line is always in the centre. This may be good in some cases, but in others, the dividing line needs to be somewhere else. With round filters, mounted in front of the lens, not much can be done to change the line, and square filters that can be moved in front of the lens are therefore preferable. I use 3 in gelatin filters for this purpose in combination with the Hasselblad professional lens shade. The slot at the rear of the shade is ideal for sliding the gelatin in front of the lens as far as necessary, and the bellows shades the filter from direct light.

When positioning the filter, you must view the ground-glass image at the aperture that will be used or, even better, determine the aperture that produces the desired results while manually opening and closing the diaphragm. You will find that the sharpness of the dividing line between the filtered and non-filtered area depends on the aperture. At large apertures, the line is very blurred; at small apertures, it becomes rather sharp and distinct. When the visual dividing line between the filtered and non-filtered areas is also sharp, such as a horizon over a water surface, the small apertures are preferred—you do not want the sky colours to flow over into the water. In other cases, when the

dividing line is a wide dark area, a large aperture may be preferred, for example a blurred outline that gradually changes within the dark area. The position of the dividing line also changes as the diaphragm is closed down.

Partial filters reduce the amount of light falling on part of the film, leaving the rest undisturbed. What exposure changes should be made? If the filter darkens or changes the colour over the main subject area, the filter factor must be considered. More often, the filter is used to darken or change the colour over a secondary area such as the sky, in which case the filter factor is not considered. The main area, the landscape, the water and the beach below the sky, is not affected by the filter and so the lens setting is the same with or without filter. The lens settings are based on the regular meter reading of the unchanged area. When the Hasselblad meter prism is used, therefore, take the meter reading and set the lens before positioning the filter.

Diffusion filters

Diffusion filters are used to add a soft poetic feeling to images or to suppress undesirable details. This is especially useful when photographing people where the diffusion filter makes blemishes and skin imperfections less visible, giving a more flattering appearance to people and reducing the necessary amount of retouching. Only a slight diffusion is necessary for this purpose.

Diffusion filters do not produce out-of-focus images but images with diffused outlines where the highlights bleed into the shaded areas. The images can be beautiful in the flat lighting of an overcast or foggy day or in umbrella lighting in the studio. The effect can be very striking on back-lighted subjects or scenes where the diffusion filter creates a sort of a halo effect around every highlight in the scene or subject. The diffusion effect can be distracting if the halo is unnatural, for example in studio portraits against dark backgrounds.

Diffusion effects can be created in many different ways, with home-made gadgets such as black nylon stockings, with vaseline on glass, with clear acetate and diffusion lenses, and with diffusion filters such as the Hasselblad Softars.

The soft-focus effect is obtained by a great number of tiny lens elements evenly distributed over the entire filter surface. The definition of the lens is retained while the contours are softened. The diffusion effect does not change while opening or closing the aperture which is a great advantage on SLR cameras. You can study the diffusion effect with the lens wide open and be assured that it will be identical at any chosen aperture.

There are three types of Softars: I, II and III. I has minimum diffusion and is recommended for an overall slight softness and for reducing skin detail when photographing people. II is a good compromise if only one diffusion filter can be selected. It is also necessary when photographing people with more pronounced skin blemishes. Maximum diffusion is given by III, and is used when a really poetic effect is desired. It is especially effective with back-

lighting. Softar diffusion filters can also be combined: I and II combined are about the same as III used alone; III and I or III and II result in extreme softness.

Another well known type of diffusion filter has a circular pattern of rings. The Hasselblad DF filter is of this type. The diffusion effect is similar to that of the Softars but depends on the lens aperture. With the lens wide open, the image has maximum diffusion. The diffusion decreases as the diaphragm is closed down, and at the minimum aperture the image is almost as sharp as without the filter. With this type, any desired degree of diffusion can be obtained with one filter, provided naturally that the aperture selected for the diffusion is also correct for depth of field.

Both types of diffusion filters are made of clear material and therefore do not require an increase in exposure and do not produce a change of colour. They can also be combined with colour filters.

Lens attachments for special effects

Multiprisms are glass lens attachments with three to six or perhaps even more different prismatic surfaces. Each prism produces its own image of the subject; the result is multiple images on the film. The arrangement of the images depends on the design of the multiprism. The Hasselblad prisms have one central field with four or five marginal sectors; one image is recorded in the centre and surrounded by four or five other images.

The effect of multiprisms depends on the aperture and, to some extent, on the focal length of the lens. Consequently, evaluate the results carefully on the ground glass with the diaphragm manually closed down to different apertures. At large apertures, the images overlap considerably producing a Softar effect. At smaller apertures, the images are more separated and distinct. Shorter focal length lenses produce more overlapping; longer lenses produce more separation by spreading the images into the corners. Also check the multiprism effect at different distances. Longer distances separate the images more. The effect with a long lens from a long distance is different to that with a short focal length lens from a closer distance, even though both may cover the same area.

Multiprisms can be rotated in their mount so that the images can be arranged in different ways within the frame. An interesting effect can sometimes be created by turning the prism while the shutter is open. A relatively long shutter speed of 1/2 to 1 sec is necessary for this purpose.

Colour prism. Multiprisms are also available with each field in a different colour. Each image is recorded in a different colour on colour film. This offers extremely interesting possibilities with the prism stationary and even more when rotating during exposure so that the various colours blend into each other. White subjects usually produce the best effects.

Starfilters and cross screens. Used with the right subject on the proper occasion

a star-like pattern can be striking in both photographs and films. It enhances the feeling of beauty and glitter, and should therefore be used when these moods are to be created. As starfilters show their effect only in highlights, images must be framed to include such highlights, e.g. lighted chandeliers, stage lights, candles, nightlights, sunlight bouncing off water, etc. Starfilters come in different versions producing four, six or eight star patterns, two of which can be combined and rotated against each other.

Fog filters. A misty, atmospheric haze effect, very similar to fog, can be obtained with a fog filter placed in front of the lens. These usually come in different densities. The lighting in the scene must be of the type existing on a foggy day, i.e. soft and without shadows or highlights.

Diffraction gratings have thousands of microscopic grooves on their surface, which act like prisms breaking white light up into all the colours of the spectrum. The arrangement of the grooves determines the colour pattern, which can be in one direction or symmetrical surrounding each light source. A bright light source shining directly on the diffraction filter is necessary. The effect can be made still more beautiful when combined with a diffusion filter.

Quality of filters

Filters used with quality lenses for critical photography must be made to the same quality standards as the lenses. This is especially important when they are combined with long focal length lenses. A filter that is not perfectly optically flat may have the effect of a very weak lens element. It may decrease image quality and make it impossible to focus the lens at infinity. The quality of filters becomes still more important when filters are combined. With deep orange and red filters, the best quality in black-and-white is obtained with so-called apochromatic lenses which are well corrected for the red and perhaps even the infra-red.

Filters between or behind the lens

With some lenses, filters can be placed inside the lens rather than at the front. The 30 mm Distagon is the only lens of this type in the Hasselblad line. The design of the 30 mm makes it impossible to attach something to the front without cutting into the diagonal field of view. In this lens the filter is part of the optical design which means the lens has been designed to produce best sharpness with the filter or clear glass in the lens.

With Hasselblad, filters cannot be placed behind the lens. Should you ever place a filter or any glass or other translucent material between the rear of the lens and film plane, keep in mind that the image plane is moved backwards approximately 1/3 of the thickness of the material. If you focus the image on the ground glass through the filter, you automatically compensate for the focus shift.

Coating and multicoating of filters

Filters should be coated when used on a coated lens. On the other hand, multicoating of a filter is more a sales gimmick as it has little, if any, value from a practical point of view. The light transmission gained by multicoating is in the neighbourhood of 1/35 of one *f* stop.

Hasselblad filter sizes

Series 50. The glass is 50 mm in diameter with a bayonet mount to attach to the inside bayonet of the Hasselblad shutter lenses with focal lengths from 80 to 250 mm and the 80 mm Planar F. The outside diameter corresponds to that of the lenses. The Hasselblad sunshade can therefore be placed over the filter and attached to the outside bayonet mount of the lenses. Each filter has an inside bayonet mount in the front to attach a second filter, Proxar or multiprism. When a filter is attached to any of the lenses, the lens cap which attaches to the outside bayonet mount can no longer be used. To protect a filter-equipped lens, you can use the transparent plastic cap from the case supplied with all Hasselblad filters or perhaps the black lens cap 50377 supplied with the lenses with automatic diaphragm control.

The 50 mm multiprisms and polarizing filters differ somewhat as they are in a rotating mount. Sunshades can be placed over the polarizer or multiprism but must be removed to rotate them. These filters do not have a front bayonet fitting, for attaching a second filter, so other filters must be placed behind.

Series 63. The series 63 filters are of the drop-in type filter corresponding to standard series VIII size with a glass diameter of 63 mm. They drop in front of the 38 mm Biogon, Distagon 50 mm *f*4 and 60 mm *f*3.5 lenses after removing the filter-retaining ring which is part of the lens. The filter is held in place by the retaining ring, by the 50–60 or 38 mm sunshade or by the ring from the professional lens shade.

You can use only one filter. If a second filter is necessary, I suggest using a 3 in gelatin in the professional lens shade. As the filter goes inside the lens, the regular 38, 50 or 60 mm lens caps can be used to protect the lens. The 63 polarizer and multiprisms have a threaded mount that attaches directly to the front thread in the 38, 50 and 60 mm lenses. This allows convenient rotating of the polarizer or prism, but the lens shades cannot be used.

Series 26 filters with an outside mount diameter of 26 mm are made for the 30 mm Distagon where they are attached to the rear of the front section. To ascertain that the lens is always assembled with a filter in place, the rear of the cone is painted bright red. If this coloured ring is visible, the filter has been left out. The Distagon 30 is supplied with four filters: orange, absorbing the light up to 570 nm (engraved as 57 on filter); yellow, absorbing wavelength up to 500 nm (engraved as 50); conversion filter B 11 for use of daylight film in 3200 K light; and, a clear glass filter. Only one filter can be used at a time.

Series 70 filters have a 70 mm diameter with bayonet mount for 110 mm F Planar and 150 mm F Sonnar. The sunshade fits over the filter and attaches to the outside bayonet mount on the lens. The filters also have an inside bayonet mount in the front so that two filters can be combined.

Series 86 filters have 86 mm thread diameter with a glass diameter of approximately 80 mm for use on 350 and 500 mm Tele Tessar lenses and the 50 mm Distagon F. They attach to the lens by means of their external threaded mount after removing the lens shade. The inside front thread allows the sunshade or second filter to be attached.

Series 93. A threaded filter for the Variogon 140–280 mm goes between lens and sunshade. The threaded front allows a second filter or the sunshade to be attached.

Series 104. The largest, 104 mm diameter, filters are made for the 40 mm Distagon. They have a bayonet mount to fit on the outside bayonet mount of the lens. Only one filter can be used. The shade cannot be used as it attaches to the same bayonet mount.

The gelatin filter holder holds 3 in gelatin filters flat and fits into the slot at the rear of the professional lens shade. It allows easy changing without the need to handle the gelatin filter itself, and also facilitates storing of filter. Using the professional lens shade, the same gelatin filters can be used on the Biogon 38 mm, on all shutter lenses from 50 to 250 mm focal length and on the 80 mm Planar F.

Other filters and sizes. The 38 mm Biogon and the 50 and 60 mm Distagon lenses take standard series 63 filters and therefore all series VIII filters made by any company should be usable in these lenses. The 58 mm filters, popular in 35 mm cameras, can be used on the 80 to 250 mm lenses by means of a bayonet adapter ring available from various companies.

Filter mounts

Should you need a special filter which is not readily available, glassless filter mounts (made in the 50, 86 and 104 sizes) are available. They are made to hold a rimless filter cut to the proper size.

Filter maintenance

Softar filters are made of clear plastic and you should therefore never use lens cleaner or any other chemical solvent for cleaning. Use a soft brush or blower to remove dust. Grease or fingermarks are removed with a soft polishing cloth, if necessary, after breathing on the surface. All other filters are made from glass and are cleaned like lens surfaces, blowing or brushing off dust first, then cleaning with lens tissue and lens cleaner if necessary.

Interchanging filter sizes

All 63 filters made for the 38, 50, 60 mm lenses can be used on all shutter lenses from 80 to 250 mm and the 80 mm Planar F by means of the Hasselblad filter adapter ring 63. The adapter bayonets on the outside of the lenses and holds the 63 filters with a filter retaining ring. This arrangement allows the photographer to use the same filters on the Superwide and on all shutter lenses from the 50 mm wide-angle to the 250 mm telephoto, although the 80 or 100–250 sunshade cannot be used at the same time. The professional shade and the 50–60 shade, however, can be attached to the filter adapter.

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Electronic Flash

ELECTRONIC FLASH HAS become the most popular artificial light source in photography. The duration of the flash is very short, shorter than the shutter speed on the camera, and therefore freezes action and helps to eliminate unsharp images due to camera movement. The colour temperature of electronic flash matches that of normal daylight and the two can therefore be combined for colour photography.

Camera–flash connection

The electronic flash must fire the moment the shutter is fully open. On Hasselblads, flash units are connected to the camera or lens shutter by means of a sync cable. If the flash is to be synchronized to the lens shutter, connect the sync cable to the PC contact in the lens or micro shutter. The flash is synchronized to the focal-plane shutter of the 2000FC by attaching the cable to the PC contact in the camera body. The flash can be mounted on the camera, held separately or mounted on a separate stand away from the camera, for which extension cables of up to about 10 m (30 ft) are available. It is possible to fire two or three flash units simultaneously by attaching a multiple connector (with two or three sync cable connectors) to the camera or lens and a sync cable from each connector to each flash unit.

Off-the-camera flash units can also be fired by slave units, which are small light-sensing devices which trigger a flash unit in response to the light from another flash. Such slave units eliminate the need for cable connections between camera and flash. One small flash, mounted on the camera, can fire one or any number of flash units off the camera as long as each is equipped with its own slave. The light-sensing 'eye' of the slave must naturally point toward the triggering flash and must also receive sufficient light to energize the slave. A small flash, or a stronger one at a greater distance, may not be good enough. Also the light from the flash must be considerably above the

level of the ambient light. A slave that may work well in a relatively dark location may not work in a well lit stadium.

The flash on the camera need not be used for lighting the subject at all, but just for firing the slave unit or units. Alternatively, the arrangement could be with the camera flash as the main light and also firing a hair or accent light, or the camera unit can be the fill light and also fire the main light.

On-camera flash

A flash unit mounted on the camera offers greatest camera mobility, but produces flat, front lighting, not the type one usually associates with portrait photography.

While this flat lighting is not often seen in portraits, it is frequently found in other images of people, for example in fashion photography, in advertisements, in glamour photographs, and in TV commercials. Even, shadowless lighting is frequently the most flattering since it creates no disturbing shadows under the eyes or at the end of the mouth when the model is smiling. The eyes, the most important part of the facial features, are always well lit, bright and shining, and wrinkles are suppressed. The best position for the flash is directly above the camera. Place the flash head several inches, or preferably one to two feet, above the camera lens to eliminate pink eye. Pink eye is caused when the flash is reflected straight back from the retina at the back of each eye. With the flash well above the camera lens, the light enters the pupil at a slanted angle and does not illuminate the retina directly behind the pupil. The lens sees a shaded area. Pink eye may also be avoided by photographing people with their heads slightly turned, rather than looking straight into the camera.

A flash placed one to two feet above the camera also casts the shadows from people's heads below their shoulders where they may not be seen. How high the flash must be to accomplish this depends on the subject-to-camera distance and the subject-to-background distance. The closer the subject to the background or the further the camera from the subject, the higher the unit needs to be. Move the subject further from the background or use a shorter lens so that you can photograph from a shorter distance and assure 'shadowless' illumination.

Flash unit size

The size of a flash unit is determined mainly by the power source which in turn determines the brightness of the flash and number of flashes per charge. A small camera-mounted flash is fine if you work mainly within about 5 m (17 ft) of your subject. On the other hand, a small flash will not give sufficient light to photograph a banquet hall or factory interior, especially when the required depth of field means small apertures.

Flash units can be powered by regular penlight batteries, usually two to four type AA size, which are ideal if you want a good number of shots at one time, yet have only occasional need for flash. When flash is needed without prior notice, the unit is made ready to go by simply inserting a new set of the easily available AA cells. The number of flashes is practically unlimited since batteries can be changed almost instantly. Standard flashlight batteries are not recommended since they have a short life and recycle slowly. Use the manganese-alkaline types which provide more flashes and faster recycling.

Rechargeable nickel-cadmium batteries are the choice of the working photographer who uses flash frequently. They can be recharged a great number of times and, if used frequently, are more economical than regular penlight batteries. Some rechargeable nickel-cadmium flash units require charging times of 6–12 hours, whilst others recharge fully in an hour or less. This rapid recharging is valuable when flash units may have to be used unexpectedly.

AC-powered units are limited to indoor use and usually consist of separate lamp heads and power pack. Up to four units can be connected to most such power packs. The lamp shades are usually mounted on light stands together with all types of reflectors or umbrellas.

Sync cable polarity

Sync cables can usually be attached to portable flash units in one way only so there is no problem about polarity. Flash cables used on studio units, however, may have plugs which can be connected either way. For safety's sake and to avoid possible damage to the sync contacts in the camera, the cable should be connected so the grounded contact on the flash unit connects to the shutter contact that is grounded to the camera body. This can be checked as follows:

Attach sync cable to power pack and camera. Touch any exposed metal part on the lamp head or light stand with an exposed metal part of the camera. If the light does not flash, you have correct polarity. If the light flashes, reverse the cable.

Modelling lights

AC-powered studio units are usually equipped with modelling lights which allow you to see the lighting effect on the subject. When lampheads of different ratings are used, the brightness of the modelling lights must be changed proportionately to see the lighting ratio and effect. As the modelling lights stay on when the flash exposure is made, they should not be too bright; otherwise, they register on the film as a secondary (ghost) image or as a slight change in exposure and colour. The effect can be avoided by using shorter speeds (1/125–1/250 sec) or by turning off the modelling lights.

Checking flash sync

After removing the film magazine from any Hasselblad camera, you can look straight through the lens and shutter. This makes it easy to check whether your electronic flash is accurately synchronized with the shutter. With lens shutters, set the diaphragm to its widest aperture and the camera at the shutter speed to be checked. Attach the sync cord to the PC flash socket in lens. Point the camera with flash unit connected to the lens or camera towards a light wall. Place your eye approximately 1 ft behind the rear of the camera and trip the shutter while looking through the back of the camera. If you see a perfect, full circle, your flash is synchronized. If the flash is not visible at all or not through the fully open lens, the flash synchronization is off. For a complete check, test at all shutter speeds, including the top speed of 1/500 sec. This test is extremely accurate and reliable, especially at the shortest shutter speed.

To check the 2000FC focal-plane shutter, remove the magazine and the lens. Set the lens at the shutter speed to be checked. Set the shutter at the shutter speed to be checked. Attach sync cable to the flash socket on camera. Place the eye approximately 1 ft behind the rear of the camera, while you trip the shutter. The flash is synchronized with the focal-plane shutter if you can see the flash over the entire $2\frac{1}{4}$ in square area. If you cannot see the flash at all or not through the full frame, flash synchronization is off. For a complete check, test at all shutter speeds up to 1/90 sec. This test is again extremely accurate.

Flash firing failures

Probably the most annoying happening in photography is when flash pictures are made and the flash does not fire. Everyone in front of the camera is aware that the photographer goofed somewhere.

Try to avoid flash failures or, if they do happen, make sure you know where and what to check. There may be quite a few reasons for this malfunctioning. Most flash units have an on/off switch which should be checked. While you look at the flash unit, check whether the ready light is on. If it is not, there may be no batteries in the unit or the batteries may be dead or very weak. The battery contact may be poor, perhaps corroded, or an AC unit may not be plugged in. Have a look at the lens to make certain the flash sync lever is at X or on the 2000FC the shutter speed is set at $\frac{1}{90}$ sec or longer. Sync cables can become disconnected from the contact on the camera or lens or from the connection on the flash.

If none of the above checks disclose the reason for the failure, remove the film magazine so you do not waste film while checking the additional possibilities.

PC coaxial plugs are not the world's best electrical connections. If one feels too loose, gently squeeze the contact with pliers into an oval shape, thereby making a firm connection at least on two sides. Take care, though—it is more often the centre contact that fails to connect. If the sync terminal on the

lens appears to be loose, have the terminal replaced by a Hasselblad service centre. If the flash is used a lot, the insulation in the terminal may wear out, permitting drain on a flash unit's capacitor. One other possibility is a defective sync cable. Try another cable if available.

If nothing helps, the fault may be in the flash connection in the shutter, which then needs a repair man. You might try another lens, or, on a 2000FC, switch from lens to camera shutter.

Filters

All electronic flash units produce a daylight-type lighting with a decamired value around 18 DM (5600 K). There are some variations between different makes.

Many units produce pleasing colours on daylight film without the need for filters. Others produce colours which might be considered somewhat on the cool, bluish side; warmer results can then be obtained with an R-1.5, an 81A, or an 81B colour balance filter.

Light output and guide numbers

The amount of light produced by a flash tube is rated in effective candle power seconds (ECPS) or beam candle power seconds (BCPS). Both measure the light output, i.e. the brightness and duration of an electronic flash unit. BCPS measures the centre of the beam of light. ECPS measures the light output over the complete angle of illumination.

Instead of BCPS, the brightness of most portable units is indicated in more photographic terms, i.e. as a guide number, which is the product of the lens aperture and distance needed for correct exposure. The guide number for any flash unit varies with the film. Most companies quote the guide number for 100 ASA (21 DIN) film. The number varies from around 13 m (40 ft) to perhaps 60 m (200 ft) depending on the size of the flash.

If the guide number for a certain film sensitivity is not available, you can determine it easily from the guide number of a lower or higher exposure index rating as follows. For an ASA rating twice as high, or the DIN rating 3 points higher, multiply the guide number by 1.4; for example, if the guide number for 200 ASA film is 220, then the guide number for 400 ASA is $220 \times 1.4 = 308$. Divide by 1.4 for an ASA rating of half or a DIN value 3 points lower; for example if the guide number for 21 DIN is 42, the guide number for 18 DIN is $42 \div 1.4 = 30$.

Covering power

Guide numbers do not tell the entire story about the performance of a flash unit. When a beam of light is controlled by reflectors or lenses, as on all flash

units, the brightness at a certain distance depends on the size of the area over which the light is spread. For example, the 60 mm Distagon on Hasselblad requires a 66° diagonal and 50° horizontal and vertical coverage. The 50 mm Distagon needs even more—75° diagonal, 60° horizontal and vertical.

There are no flash units on the market that will cover the area of a Hasselblad 40 mm lens or the Superwide camera. For these, indirect or bounced flash, multiple flash or bare bulb can be considered.

Zoom flash. While wide-angle coverage is necessary or desirable when wide-angle lenses are used, much of the light is wasted when normal and tele lenses are used. It was therefore only logical for flash manufacturers to introduce zoom flash units, where the angle of the light can be changed as the angle of view is changed.

Wide-angle adapters. The flash light can also be spread over a wider area with a wide-angle attachment. The attachment is placed in front of the tube when wide-angle coverage is desired, and removed for the brightest light output over a smaller area. The guide number with the adapter is lower than without.

Determining aperture

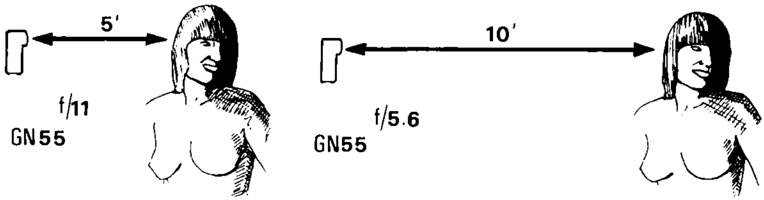
On a manual unit, or an automatic unit set to manual, the correct aperture depends on the flash-to-subject distance, which is where the guide number comes in. To obtain the correct aperture divide the guide number into the flash-to-subject distance. (Note that guide numbers are given either in feet or in metres, and you must choose the same units.) For example, if the guide number is 110 ft and the subject 10 ft away, the correct aperture is $110 \div 10 = f11$.

Instead of determining aperture from guide numbers, you can calculate the flash distance for any aperture. For example, to use *f*11 with a guide number of 33 m, the correct flash distance is $33 \div 11 = 3$ m. Most units have tables or calculators to do these sums for you.

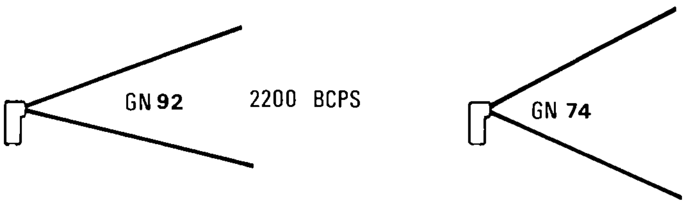
Guide numbers for amateur flash units are established on the assumption that flash pictures are taken in average-size living rooms with light-coloured walls and ceilings which reflect a certain amount of light. If flash pictures are taken in large halls or in dark rooms, a somewhat larger aperture may be necessary.

Shutter speed

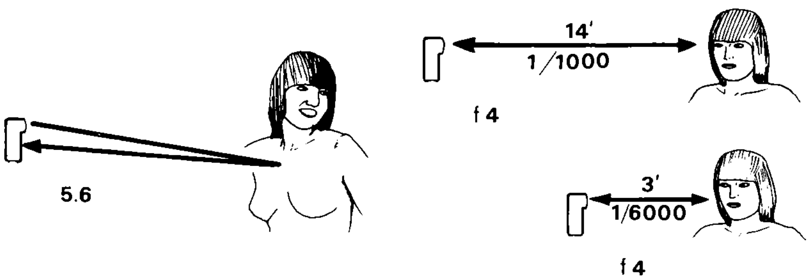
Electronic flash duration is shorter than 1/500 sec, so the shutter speed has no effect on flash exposures. The correct exposure depends only on the lens aperture. The shutter speed does determine, however, how much of the ambient light is recorded on the film. Almost invariably, there is some ambient light but it is usually too weak to record on the film at short speeds (say 1/125



To decide the correct aperture for a flash photograph, divide the guide number into the distance between the flash and subject. For example, if the guide number (GN) is 55 and the distance 5 feet then the correct aperture is *f*/11 (55 – 5 = 11). With same guide number but at twice the distance, the correct aperture would be *f*/5.6 (55 – 10 = 5.5).



Although two flash units may have the same BCPS power, they may have different guide numbers. This is because the flash with the lower guide number spreads the light over a larger area than that with the higher number. Area coverage of a flash unit must therefore be considered in exposure calculations.



On automatic flash units, a sensor in the flash measures the light as it is reflected from the subject and switches off the unit when it has received the correct amount of light for the set aperture. The duration of the flash is therefore determined not only by the aperture but by the flash-to-subject distance. For example, at an aperture of *f*/4, the flash may be on for $\frac{1}{1000}$ sec if the subject is 14 feet away but only for $\frac{1}{6000}$ sec if the subject is 3 feet away.

sec and shorter). The result is the typical obvious flash illumination with dark backgrounds and surrounding areas.

If you choose 1/30 sec, or perhaps even 1/8 sec, the flash exposure remains the same, but the ambient light is also recorded on the film. The natural light in the room becomes part of the picture, a living room looks like a living room. The flash then becomes almost the secondary rather than the main light. The effect is especially beautiful and natural with incandescent lights, which produce a much warmer colour than the flash. Using longer exposures is most effective when the flash is off the camera and used as a sidelight. On the camera, the flash also throws light and shadows on the background, somewhat destroying the natural feeling. The lighting effect and ratio can be predetermined accurately. The principle is the same as when combining flash and daylight outdoors (p. 214).

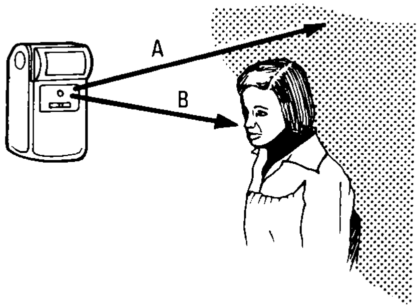
Ghost images

When flash is used with moving subjects, the ambient light may produce a blurred secondary image, usually called a ghost image. The final picture consists of two images, one sharp from the flash and one blurred from the existing light. In well lit rooms such as sports arenas or gymnasiums, a secondary ghost image may be recorded even at the relatively short shutter speed of 1/90 sec that is needed for flash synchronization of the 2000FC focal-plane shutter. For this type of photography, full flash synchronization up to 1/500 sec is a prime requirement. It is the only way of eliminating ghost images.

Automatic flash

As the flash-to-subject distance determines the aperture setting on the lens, every change in flash distance requires a change in the lens setting. This adjustment is eliminated by using an automatic flash unit, which is equipped with a sensor pointing in the same direction as the flash head. The sensor picks up the light reflected from the subject, just as a reflected-light meter does. As soon as the sensor receives the correct amount of light for the aperture setting on the lens, the flash instantly cuts off the light. The further away the flash is from the subject, the longer the flash duration. In a group picture at 15 ft the flash may be on for 1/1000 sec; in a 2 ft close-up, it may be as short as 1/30000.

Automatic units are convenient because they eliminate calculations and possible mistakes, but they do have some drawbacks. Since the film sensitivity determines the aperture, and consequently the depth of field, changing to a faster film does not increase the range of the flash, but only permits photographing at a smaller aperture. To increase the range, the unit should be used on manual. Some flash units offer only one aperture for a certain film sensitivity; others give a choice of three or more apertures. Most units also offer



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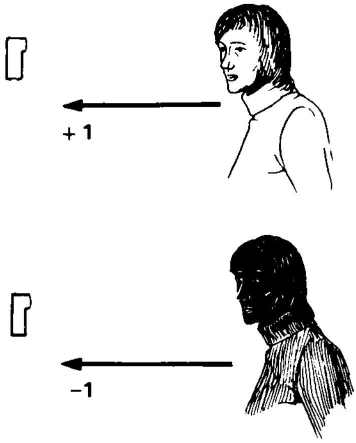
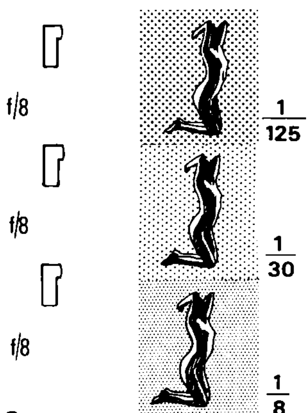


2.

The sensor of an automatic flash unit calculates the duration of the flash from the amount of light reflected back to it from the central area. Thus if the main subject is not positioned in the centre, the exposure will be based on the background areas (**1**A). With the main subject in the centre, the exposure will be correct (**1**B).

Another problem when using automatic flash is the amount of light reflected by the subject (**2**). For example, a lighter-than-average subject reflects more than the average amount of light and will therefore be slightly underexposed; opening the diaphragm one stop may compensate for this. Conversely a dark subject will reflect less light to the sensor and keep the flash on too long; closing the diaphragm one stop will give the correct exposure.



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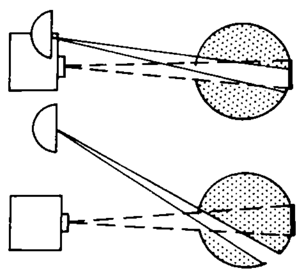


4.

The exposure for flash is determined only by the aperture and in a dark room is unaffected by the shutter speed. Where there is some ambient light, however, the shutter speed will determine how much is recorded on the film. For example (**3**), at an aperture of *f*/8, a shutter speed of $\frac{1}{125}$ sec will record very little background detail whereas one of $\frac{1}{8}$ sec will give a much lighter background.

Using on-camera flash when photographing people often produces 'pink eye' which is caused by reflection of the flash light off the back of the blood-filled retina (**4** top). You can avoid this by placing the flash further from the camera so that the retina is shaded (bottom).

a manual mode in which the sensor has no effect and which gives the full flash every time.

Automatic units provide surprisingly accurate exposures as long as you stay within the distance range indicated on the flash unit, and as long as the sensor points at a main subject that is sufficiently large in size to be read by the sensor. Keep in mind, however, that the sensor reads reflected light and the reading is affected by the reflectance of the subject. Exposure is most accurate when the subject reflects about 18% of the light. A bright subject, reflecting more light, shuts the flash off too soon, resulting in underexposure; compensate by opening the aperture one half to one stop. A dark subject keeps the flash on too long, causing overexpose; compensate by closing the aperture one half to one stop.

Automatic units have also a tendency to overexpose subjects nearer than about 1 m (3 ft) because the flash duration is extremely short, and the slightest delay from the sensor may keep it on longer than necessary. An aperture one stop smaller than recommended may, therefore, be advised for close-ups. A film test at various distances may be advisable.

Energy-saving circuits

Most recent flash units have energy-saving circuits, which means that the moment proper exposure is obtained, a switch in the thyristor circuit closes so that the remaining power can no longer escape from the capacitor. The time required to recharge the only partially emptied capacitor is shorter than to charge an empty one, and recycling time therefore is shorter. The differences can be very dramatic, perhaps 1/2 sec recycling time compared to 6 sec.

It also takes less power to recharge a partially empty capacitor. The batteries in the flash unit, therefore, last longer, and allow a larger number of shots before they have to be replaced. The difference, especially in close-ups, can again be very dramatic, perhaps 1500 shots compared to 50.

If the recycling time is less than 1 sec, energy-saving units can be used with motor-driven Hasselblad cameras for continuous shooting.

Ready light

The ready light indicates when the capacitor is charged, and thus when the camera can be released again. If a picture is made before the ready light is on, either the flash will not fire, or will fire with less than the full amount of light, which is a frequent reason for underexposure.

On professional units, especially the studio types, it can be assumed that the ready light does not come on until the capacitor is 100% charged. On many amateur units, this is not so since manufacturers try to shorten the recycle time for sales reasons and the ready light comes on when the capacitor is only about 70% charged, which may be good enough for amateur snapshots. If

flashed at that moment, however, pictures may be as much as one stop underexposed at maximum distance or when working manually. To assure perfect results with such units, it is recommended to wait 50% longer than the recycling time.

If the ready light takes 30 sec or more to light up, the batterys are probably exhausted.

Exposure control signal

Many automatic flash units have an exposure control signal, which lights up immediately after the flash if the sensor picked up enough light for correct exposure. The exposure control signal is a confidence builder in direct flash when the subjects are near the maximum distance. It is extremely valuable when using indirect flash with umbrellas, reflectors or bounced flash, where part of the light is absorbed and the indications on the chart no longer apply.

The value of the exposure control signal is not so much while taking a picture but before. You can fire a test flash to see whether the control signal lights up. If so, you can take the picture with the confidence that it will be properly exposed. If it does not light up, move closer, change to a faster film, use direct instead of bounced flash, set flash to a longer distance range, or use the flash manually at a larger aperture.

Vario power

Many modern portable flash units today also include a capability that has been found in studio units for years—variable power output, which is the thyristor concept applied to manual operation. By changing a switch, the amount of light is reduced to 50%, to 25% or frequently up to 1.6%, so that little energy is used up at any distance and recycling time is shortened considerably.

The short recycling time of less than 1 sec is one main advantage of vario power. It allows flash operation with the Hasselblad EL set to A or AS. Such short recycling times can also be obtained with automatic units, but only at very short distances. With vario power, they are reached at all distances within the range, which at 100 ASA can easily be up to 1.8 m (6 ft) at *f*2.8 and with 400 ASA up to 3.6 m (12 ft) at the same aperture. With vario power, you are no longer limited to one *f* stop with a certain flash distance, or to any specific distance with one *f* stop With two vario-power flash units, you can set lighting ratios with the vario-power switch.

Indirect and bounced flash

Indirect flash, with the light reflected off umbrellas, reflectors, walls or ceilings, rather than shining directly into the subject, produces a softer overall light. The light illuminates the subject from various angles and therefore reduces or eliminates harsh, sharp shadows.

Umbrellas. White or silvered umbrellas offer the simplest, most portable solution for indirect flash illumination. Flash unit and umbrella are mounted together with the flash tube pointing at the centre of the umbrella. The umbrella is folded when not in use. The softness of the lighting produced by umbrellas, and any other reflectors, is directly related to their size and distance. The larger the umbrella or reflector, the larger the spread of light. Close to the subject, the light from the umbrella or reflector reaches the subject from different angles, producing an almost shadowless light. The same umbrella or reflector far from the subject becomes more a point source of light, producing stronger shadows, almost like direct flash.

For the softest light use the largest size umbrella, positioned close to the subject. A soft lighting similar to umbrella lighting can be obtained with portrait studio lights. They have a large reflector (50–60 cm, 20–25 in), shaped almost like an umbrella, behind the flashtube; in front of the tube is another small reflector. All the light reaching the subject is reflected off the large reflecting surface.

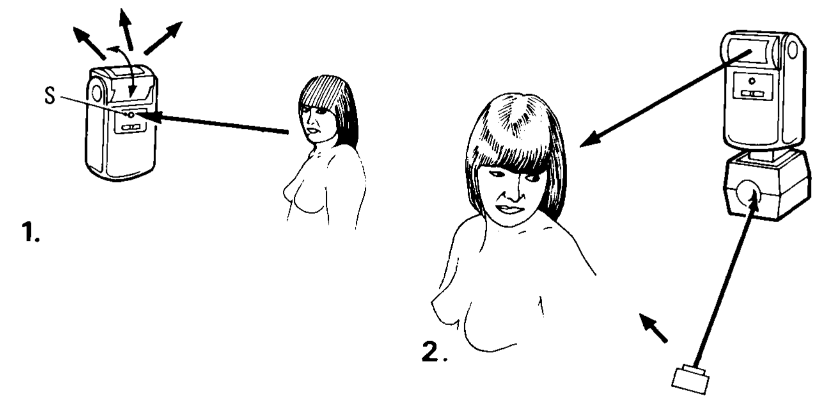
Reflectors serve the same purpose as umbrellas except that they are flat instead of the curved umbrella shape. Some reflectors can be folded for easy transport. Reflectors may be nothing more than sheets of cardboard, or the foldable types made commercially. Flat reflectors can also be used outdoors for reflecting sunlight into the shaded areas of a subject.

As with umbrellas, the softness and direction of the lighting are determined by the size of the reflector and the subject-to-object distance, and furthermore by the type of reflecting surface. White reflectors, white fabrics or cardboard, produce the softest illumination but reflect the least amount of light and need to be close to the subject. Silver and gold reflectors are readily available or can be made from crumpled aluminium foil. They reflect a large amount of light but it is a rather directional and harsh light. Gold produces a very warm light which can be desirable when photographing people in the shade of green trees or to add warm reflections to a product.

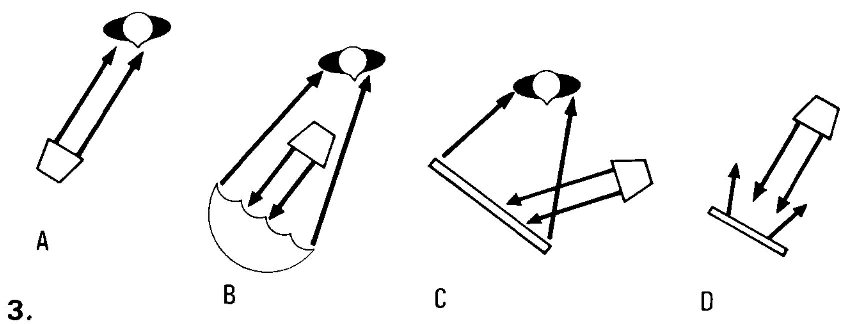
Walls and ceilings in a room can be used to bounce flash. Ceilings are satisfactory for long and group shots, but are not very good for portraits. Illuminating people from above is not very flattering; it produces shadows under the eyes and little light in the eyes, especially when the light comes from a steep angle.

Bounced lighting can be improved by adding some direct light. Point the flash head towards the ceiling as for bounced light but attach a small piece of paper (about 10 × 10 cm, 4 in square) to the top of the flash unit. A small amount of light is then reflected off the paper and may be just enough to fill the shadows in the eyes. Some of the newer flash units incorporate this principle.

Bounced wall and ceiling light can be combined by pointing the flash into a corner of a room. The softest light comes from a wall behind the camera. It is like a shadowless frontlight.



1 Flash units do not always need to be pointed directly at the subject. Those with swivel heads are ideal for indirect flash; they can be pointed in many directions and the flash bounced off any convenient surface. In such units, the sensor (S) which controls the duration of the flash is usually pointed at the subject, irrespective of where the flash points. Beware of bouncing the light off of the ceiling as this can cause unflattering shadows under the eyes, particularly when the camera is close to the subject.
2 Flash units with a slave attachment can be positioned away from the camera and fired by light from the camera flash. The on-camera flash is then aimed at the slave unit. On firing it triggers the photoelectric sensor of the slave which in turn fires the remote flash.



3 A flash unit need not necessarily be pointed directly at the subject (A). Other arrangements, such as firing the flash into an umbrella (B), at a flat reflector (C) or a mini reflector (D), give less directional illumination.

With bounced flash, the flash-to-subject distance is the total distance the flash travels, from camera to ceiling or wall *plus* the distance from ceiling or wall to subject. Furthermore, some light is absorbed by the wall or ceiling. For white ceilings or walls set the aperture two stops larger than indicated on the chart. Test exposures are recommended.

Diffusion filters. Some flash units come with diffusion filters which can be placed in front of the flash tube. A diffusion filter can spread the light over a larger area, as discussed under covering power (p. 205), but it can produce a softer illumination only if the filter is much larger in diameter than the flash head. If the ceiling is low, however, a diffusion filter over the flash head throws somewhat more light on the ceiling thereby softening the effect of direct flash. With bounced light, the diffusion filter scatters light over a wider area of the wall or ceiling creating an even softer and more even lighting.

The soft box, which has become a most popular light source in portrait photography, is nothing more than a flash head with a large diffusion screen in front of it. The diffusion screen, usually made from a white, translucent fabric, is approximately 60 cm (2 ft) square so the light no longer comes from a point light source. The lighting effect is practically the same as from an umbrella, but the soft box is more compact and requires less working space.

Automatic flash units in indirect light

You can use automatic flash units on automatic with bounced lighting as long as the sensor points at the subject. On many portable flash units the flash head alone can be swivelled either up and down or sideways or both. The sensor remains pointing at the centre of the viewing area. You can aim the camera-mounted flash anywhere, the straight forward looking sensor always measures the light reflected into the lens.

When the flash is taken off the camera and used as a side light, an umbrella light, the sensor on the flash goes too. For such cases, a remote sensor is available for many units. It works like the sensor in a flash unit but it is a separate accessory. The sensor is mounted on the camera and again measures the light reflected into the lens regardless of how and where the flash unit is used. The remote sensor actually works like a flash meter held at the camera but is connected to the flash unit with a cable to turn it off as soon as the sensor receives the correct amount of light.

If a remote sensor is not available, use the off-the-camera flash unit on manual.

Combining flash and daylight

Electronic flash is an ideal light source to combine with daylight as its colour temperature matches sunlight closely. It can therefore be used in black-and-white and colour photography.

There are many cases where electronic flash can help make better or more effective daylight pictures: outdoor portraits, fashion shots, publicity pictures, and family snapshots are very beautiful when the sunlight is used as a back light or strong side light but the contrast between highlights and shadows is likely to call for a fill-in light in the shaded areas.

Daylight from a window is useful for informal indoor portraits but is very directional. The shaded side of the face may need fill-in light to bring the contrast to a pleasing, acceptable level. Fill-in light is necessary when room interiors are photographed towards windows to show the room interior and the view outside the window. When photographing sunsets or sunrises, exposure is based on the sky, and foreground subjects are then silhouetted. Flash can be used to light them.

In all the above cases, flash is used as fill-in light but flash can also be used outdoors as a main light. When photographing in flat overcast lighting, the flash can take the place of the missing sun. Flash can also be used as an accent light, to add highlights to products or a hair light to portraits which may be missing on an overcast day or when photographing in the shade.

In all cases, the effectiveness of the image depends on the lighting ratio between the daylight and the flash which is the result of flash placement, choice of lens aperture and shutter speed.

Whenever flash is combined with daylight it is recommended to use automatic flash units on manual, which gives greater freedom in the placement of the flash units and produces consistent results regardless of the existing light or the position of the sun. If used on automatic, the sun shining on the sensor may affect its reading; set to manual, the sensor is inoperative.

Outdoor flash as a fill-in light. Flash is used outdoors mostly for filling in shaded areas. For photographing people, consider the smallest shoe mount unit you can find. You need very little light, since the flash is seldom more than 3 m (10 ft) from the subject, and outdoor portraits are then made at large lens apertures to blur out backgrounds. Start by taking a meter reading of the daylight. When photographing outdoors through glass doors or windows, take the meter reading through the glass. Set the lens to the correct exposure value. Every aperture and shutter speed combination of the coupled ring now produces correct exposure for the daylight. Next, determine the combination of aperture and shutter speed that produces correct exposures for the daylight and the flash.

The next step is to find out from the chart on the flash unit or its guide number what distance is necessary for correct exposure at the selected aperture. On a small portable unit the chart may read: *f*2.8, 9 m or 30 ft; *f*8, 3 m or 10 ft; *f*16, 1.5 m or 5 ft. Set the flash at these distances for a 1:1 lighting ratio.

A 1:1 lighting ratio (same brightness for flash and daylight) rarely produces the most desirable image. Pictures of people, especially, look overflashed, so the flash should be reduced without changing the exposure for the daylight. To reduce the flash portion one *f* stop, simply move the coupled

aperture/shutter speed ring to the next smallest aperture leaving the flash unit at the original distance.

If you have a variopower unit, the flash:daylight configuration and changing of lighting ratio is even simpler. Take a meter reading (preferably EV) of the daylight, set the lens on the EV value and decide which aperture/shutter speed combination to use. Set the variopower control so that the selected aperture is opposite the flash-to-subject distance and you automatically have a 1:1 lighting ratio. To cut down the flash exposure for a 3:1 ratio, set the variopower control one notch lower—to $\frac{1}{8}$ instead of $\frac{1}{4}$. For a two stop difference, set it two notches lower—to $\frac{1}{16}$ instead of $\frac{1}{4}$.

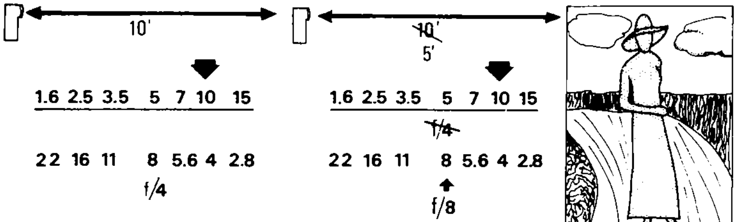
Flash as a main light outdoors. The flash can also be considered the main light rather than the fill-in, in which cases you may want to change the lighting ratio by making the daylight portion darker or lighter. A typical example, from hotel literature, is of a couple enjoying a meal in front of a large glass window with a view of the city skyline or the hotel swimming pool. The couple and the food on the table illuminated by flash must be exposed properly. There is nothing wrong in using the 1:1 lighting ratio but making the view through the window slightly lighter may look more natural, or you may want to produce the feeling of dusk by making the daylight darker. In either case, you have complete freedom to record the daylight as bright or as dark as you want it without changing the exposure for flash. To do this you change shutter speeds only. As long as you leave the aperture undisturbed the flash exposure remains the same.

Flash used as a main light can be a front or side light. It may be used not only to improve the lighting, but perhaps to stop motion in moving subjects or permit hand-held photography when the daylight alone may be too dim to do so.

Flash as an accent light. To place a highlight on a leaf or flower, a hair light on a portrait, or an accent light on a product, the flash should be either a strong side light, a back light or an overhead light. It should not light the side of the subject facing the camera. Exposure is based on the daylight only, disregarding the flash. The lens settings with the flash are exactly the same as without, i.e. based on the meter reading.

The only remaining question is the distance of the flash. The flash–subject distance determines how bright the accent light will be. It is not too critical, but as a good starting point place the flash at half the distance required for correct exposure at the selected aperture (based on the chart of flash units or guide numbers). The short distance is to ensure that the accented area is brighter than the rest. Half the distance overexposes the area sufficiently.

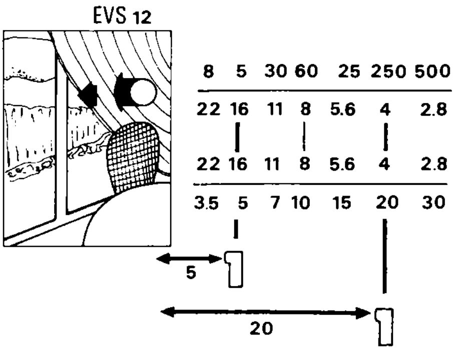
Coloured flash. Striking and fascinating effects can be obtained by combining daylight with coloured flash. Transparent papers or gels of any colour can be placed over the flash head. The flash can be positioned to serve as a main or an accent light. I have photographed tombstones in a cemetery and white birches this way against the evening sky at dusk. I used two flash units



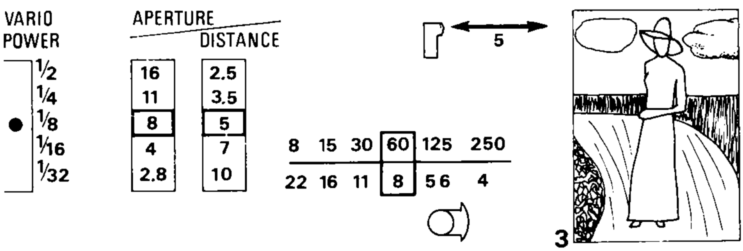
1

When combining flash and daylight, determine the aperture from the flash chart, for example *f*4 for 10 feet. Take a meter reading of the daylight and find the shutter speed that corresponds to the selected aperture, e.g. $\frac{1}{250}$ sec. This is the correct setting for a 1 : 1 lighting ratio. To change the lighting ratio you can vary either the shutter speed or aperture. With aperture constant the flash exposure remains the same and the daylight area can be lightened or darkened by varying the shutter speed. The flash exposure is changed by keeping the same EV value and turning the cross-coupled aperture/shutter speed rings.

If the shutter speed cannot be used, with a focal-plane shutter for example, use a different lens setting that produces the same daylight exposure, e.g. *f*8 at $\frac{1}{60}$ sec. As indicated on the flash chart, the flash unit must now be moved to 5 feet.



EVs are ideal for determining lens settings for flash/daylight combinations. Take a daylight meter reading and set the lens at the correct EV. Every combination of shutter speed and aperture then provides the correct exposure for daylight; decide which one provides the most satisfactory image and then place the flash at the corresponding distance, for example at 5 feet at *f*16, at 20 feet at *f*4 and at 10 feet at *f*8.



3

To set the variopower unit, take a meter reading of the daylight and set the aperture and shutter speed combination you wish to use, e.g. *f*8 at $\frac{1}{60}$ sec. Determine the flash-to-subject distance and set this opposite the aperture on the Variopower dial. This setting produces automatically the correct amount of fill-light for a 1 : 1 lighting ratio. The amount of power used is shown on Variopower dial ($\frac{1}{8}$ in above example).

covered with different coloured gels, lighting one tombstone or tree in one colour, the one next to it in a different colour. Aperture and shutter speeds are determined as for white flash, but keep in mind that the colour filters absorb some of the light and the flash must therefore be closer than the chart indicates or the lens aperture must be larger. If you have a flash meter, distances and aperture can be determined accurately.

Hasselblad flash facts

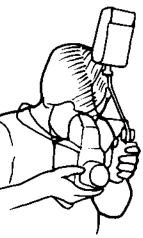
Sync contacts. When using the lens shutter, the sync cable is always connected to the contact on the lens. This applies when C lenses are used on the 2000FC, and the shutter in the lens is used, rather than the focal-plane shutter. All shutter speeds from 1 to 1/500 sec and B can be used.

The flash is synchronized to the focal-plane shutter of the 2000FC, if the sync cable is connected to the contact on the side of the camera body. Synchronization is possible only at shutter speeds from 1 sec to 1/90 sec and B. If the shutter is set at a higher speed, the flash will not fire. This flash synchronization works with all lenses, with Hasselblad lenses with and without shutter, with special lenses like Luminars, or when no lenses are used on camera as in photomicrography.

500C and 500C/EL models made before 1976 included a flash contact on the side of the camera body next to the cable hook opening which fired an electronic flash unit the moment the rear curtain was fully open. It is used only when the cameras are used without lenses, as in photomicrography, or with special lenses without shutters such as the Luminars. This flash contact has now been removed as most photographers prefer using the micro shutter for these special applications.

Use of cable hook. The flash cable contact on the 2000FC camera body is a friction type. It holds the flash cable securely to prevent it from coming off while photographing. The contact on the lenses and micro shutter does not provide this security and the flash cable can become disconnected, especially when it is stretched as, for instance, when the flashgun is hand-held above the camera. You can prevent this by placing the sync cable through the cable hook. The cable hook, supplied with Hasselblad cameras, is a little hooked device that fits in the hole on the side of the camera. The sync cable coming from the lens is wound around the hook, and can be held there with a tiny piece of tape. When you stretch the cable, it stretches only between the flash unit and the cable hook and, consequently, is not likely to become disconnected from the flash contact on the lens.

Flash synchronization. The focal-plane shutter of the 2000FC is always synchronized for electronic flash at speeds up to 1/90 sec. The shutter in the lenses is synchronized for electronic flash only when the sync lever is set at X. It can be left in the X position at all times even if flash is not used. You must move it *only* when flashbulbs are used, in which case it is moved to M, *or*



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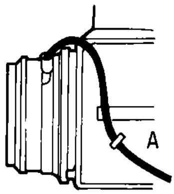

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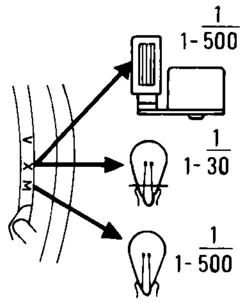
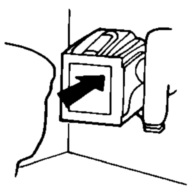


3.

A good position for a flash unit is above the camera lens high enough to avoid pink eye. This is possible with the flash gun bracket and extension arm(**1**). The flash cable can be kept on the sync socket by placing the cable through the cable hook (**2**).

3 On shutter lenses set to X, electronic flash can be used at all shutter speed up to $\frac{1}{500}$ sec. Set to M, flash bulbs can be used at all shutter speeds. Flashbulbs can also be used at X up to $\frac{1}{30}$ sec shutter speed.



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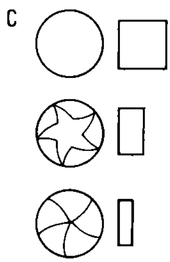
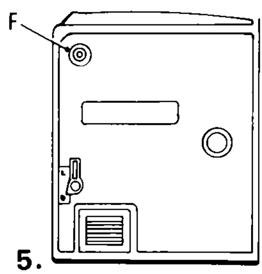
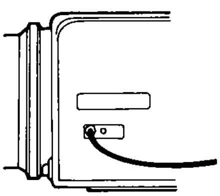




5.

4 To check flash synchronization, look through the back of the camera while releasing the camera with the flash attached. You should see a fully open lens with shutter lenses or a full square with the 2000FC focal plane shutter. Any other positions mean that the synchronization is out.

5 When the 2000FC focal-plane shutter is used with flash, the cable is connected to the sync socket (F) on the camera body.



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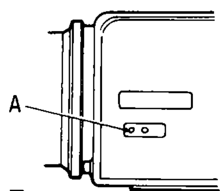


7.

When the lens shutter is used on any camera, connect the cable to the sync socket on the lens (**6**).

7 Older 500C/M and 500EL/M cameras were also equipped with a sync socket (A) on the camera body next to the cable hook opening. The sync cable is connected there only when the camera is used without a lens as in photomicrography or with a non-shutter lens. The flash fires when the auxiliary shutter is fully open.

when the self-timer is used, in which case the V setting is necessary. The lever moves back to X automatically after every self-timer exposure.

Flash synchronization with self-timer. The shutter in the lenses is synchronized for electronic flash at all shutter speeds and also when set to the V self-timer setting. Self-timer exposures with electronic flash can therefore be made.

Flash with the Hasselblad. Shoe mount flash units can be mounted directly on Hasselblad SLR cameras. Two accessories are available for this purpose. The adjustable flash shoe attaches to the accessory rail on the side of the cameras. The flash lights the subject slightly from the side and the same height as the lens. When the camera is turned 90° for shooting verticals in the 4.5 × 6 cm size, the flash is above the camera lens. The other accessory—the attachment for flash—attaches to all square sunshades (not the professional shade). Mounted on top of the shade, the flash head is above the camera lens.

With both accessories, a sync cable is used to connect the flash to the focal-plane or between-lens shutter. While both accessories hold practically any portable shoe-mounted unit, they are built and recommended only for the small, lightweight types. The shoes on both accessories can be swivelled.

Hasselblad does not make accessories for fitting shoe-mounted flash units to the Superwide.

Shoe-mounted flash units of any size can be placed on top of the Hasselblad flashgun brackets or the double hand grip. Connection to the shutter is made by means of a sync cable. With both, the flash is on the left side, slightly above the camera lens. You can place a shoe-mounted flash unit approximately over the centre of the lens by adding the extension arm to the double hand grip or the flash gun bracket.

Special brackets for pro units. Professional flash units are connected to cameras for carrying and shooting with brackets that attach to the camera's tripod sockets. You can buy such brackets in different designs and in different price ranges. The type preferred by wedding and news photographers brings the flash head 15–30 cm (6–12 in) above the camera lens. This flash position gives a flat lighting without distracting shadows and without pinkeye effect. For use with Hasselblad, such a flash bracket should extend on the left side of the camera to leave the right hand free for advancing the film. If the flashgun is also used off the camera, a quick coupling device between bracket and flashgun is highly desirable. You can then remove and attach the flash unit instantly. Select a bracket that allows convenient and steady holding of the camera while shooting. If the camera is also used on the tripod, a bracket that allows easy switching from tripod to hand-held use should be investigated. A bracket with tripod socket might be the answer.

Hasselblad ringlight

Lighting without any shadows on the subject is obtained when light of equal intensity reaches the subject from all directions. All shadows then cancel each

other out. Such lighting can be produced by a large umbrella or reflector, placed close enough to surround the subject.

For close-up photography, such a set up is rather impractical. Fortunately, another solution exists to surround small objects with light. You can mount the Hasselblad ringlight on the outside bayonet mount of the lenses from 80 to 250 mm focal length, and on the inside thread of the 50 and 60 mm Distagon after removing the bayonet adapter on the ringlight.

The ringlight is an electronic flash unit with the tube bent almost completely around the lens. The subject is lighted evenly from all sides provided the light-to-subject distance is short, but not shorter than 100 mm (4 in). At shorter distances, lighting is no longer even.

When the ringlight is far away, it becomes almost as directional as an ordinary flash unit. There is no reason for not using the ringlight at longer distances, just don't expect shadowless illumination. Actually a ringlight is also not completely shadowless at close distances, a slightly dark halo can be seen around the subject.

The ringlight is made for all close-up work when flat, shadowless lighting of three-dimensional subjects is desired. It is extremely popular in medical photography. The greatest value of the ringlight comes when photographing the inside of radios, TV sets and machinery where it is practically impossible to light every corner and eliminate disturbing shadows in any other way. Its 65° angle of coverage is more than sufficient for the angle of view of the lenses 80 mm and longer which are normally used for close-up work, but it does not provide full corner illumination with the 50 mm or 60 mm Distagon. On the 60 mm, the fall off is hardly visible.

The power for the new ringlight introduced in 1978 can come from any powerpack not exceeding 250 W with a charging voltage between 250 and 360 V. Connecting cords for some popular European powerpacks are readily available. If your powerpack is of another make, cut the plug on the cable and attach a plug to fit your unit. There are only two wires in the cable that need to be connected. It is suggested that you check the polarity as recommended earlier. The sync cable with PC connector is permanently attached to the ringlight.

The watt-second capacity determines the brightness or the guide number. For example, with 180 watt-seconds and 64 ASA film, the guide number is 15 (45), i.e. *f*16 at a distance of 0.9 m (3 ft).

Keep in mind that guide numbers for an electronic flash unit are also determined by the reflector. The guide numbers on the flash unit from which you use the powerpack do not apply to the ringlight. The reflector in the latter is less efficient. You will, therefore, probably find that the guide numbers in the ringlight chart are only about a half or a third of the guide number for a normal reflector. Nevertheless, the ringlight obviously provides more light than necessary for some close-up work so you may want to set the power pack for half power if possible.

The Hasselblad ringlights made up to 1977 looked like the present unit but required a 500V powerpack. It was changed to the lower voltage because most 500V units had been discontinued. The new units are most easily distinguished from the old by the '300–360V' engraved on the plate next to the connecting cable input and the '300V' engraving on the tube itself.

16

Instant Film

Instant film material for economy, accuracy and assurance

While the Polaroid film magazines were not brought on the market to make an instant snapshot camera out of a Hasselblad, you can use the combination to produce instant souvenir pictures of the people around you, or to produce personal picture postcards on a trip to send home to your friends and relatives. The instant film magazines were added to the Hasselblad line so that the serious amateur and professional photographers could see on a print the results provided by the lighting set-up and the camera settings, which enables you to make changes and experiment. It eliminates guesswork, and saves on film and laboratory costs. It also serves as the greatest teaching tool since it allows the student to see instantly the results of the teacher's approach, just as videotape allows an athlete to study his motions instantly or a recording tape allows an instant test of the sound quality and effectiveness.

Exposure testing

Checking correct exposure is usually the first application that comes to mind. In ordinary lighting situations, you should have no problem in obtaining perfect exposures based on an exposure meter reading. Instant film is most useful under unusual lighting situations or when combining different light sources. The exposure latitude of instant films is not as wide as regular negative or slide films and lens settings must be correct to within one half *f* stop.

A *good* exposure on instant film should, therefore, be a *perfect* exposure on other film materials. Exposure tests on film can be valuable especially in extreme low-light situations, in photomicrography and photomacrography when special lenses like the Luminars are used and when photographing directly into light sources, to determine not only the most effective exposure but check for possible flare. Exposure tests are valuable with bounced flash.

When you use Polaroid film for checking exposure, remember you are checking it on a *print* and the settings will be correct for negative material

where you want details in the shadows. For transparency material the instant print should be correctly exposed for the highlights.

Checking lighting ratios

In multiple flash set-ups, lighting ratios can be checked with flash exposure meters. If the modelling lights on studio units are directly related to the power of each flash unit, lighting ratios can also be checked visually. For lighting ratios, film tests are not really necessary; what they are valuable for is being able to see the effectiveness of the lighting, how and where shadows fall on the subject and the background, and detect possible disturbing highlights on eyeglasses or other shiny surfaces. When the light from different light sources is combined, Polaroid material becomes still more valuable.

An instant picture is a must for determining exposure as well as the effectiveness and evenness of the lighting when painting with light.

Producing special effects

An electronic flash unit fired several times while the camera shutter is open produces multiple images. For example, dancers can appear several times in different positions, in different areas of the film in the same size or smaller or larger each time, perhaps even in different colours. The effectiveness of such pictures depends mainly on the positioning of the various images within the frame. They can be completely separated or overlap partially or completely. An image on film is the best or only way to check this. When double or multiple exposures are made in the camera, the final result can also only be seen on film, not in the viewfinder of the camera.

Test shots to determine the effectiveness of the final image and the exposure settings are a necessity. In this case, you must consider the narrower exposure latitude of Polacolor film. A one stop change in aperture is more visible than on slide and negative films. If you underexpose each image by one and a half *f* stops as recommended in the chapter on double exposures, underexpose each image by one *f* stop for the test. This is about equal to one and a half *f* stops on negative or transparency films.

Effects of shutter speeds

There is no way that you can see with your eyes or in the viewfinder how the shutter speed affects or changes the image of a moving subject.

If you want to stop action, you can follow written guidelines which indicate how short the shutter speed must be to record some of the common moving subjects completely or reasonably sharply. Such guidelines are difficult to give when it is desired to record the moving subject with a blur to enhance the feeling of motion.

There are two solutions: either photograph the moving subject at different shutter speeds and pick the best when the film comes back from processing, or make a test on instant picture film at one shutter speed; if the results are not satisfactory, shorten or lengthen the shutter speed to get more or less blur, and repeat the process until the instant picture shows exactly the desired results.

It is also a good idea to use instant film when the camera is moved to produce the blur; when the focal length of a zoom lens is changed while the shutter is open to produce a zoom effect; when the focusing ring on the lens, vignettes or other accessories in front of the lens are moved; or when electronic flash is combined with slow shutter speeds.

As a teaching tool

In all the above applications, the instant film material helps you to create the desired image on the film. A special advantage in using this photographic material is for teaching and training purposes. The value here is not in the photographer being able to see the results, but to give others visual proof of the happening immediately. This can be for the purpose of showing photography students immediately the result of a photographic approach under discussion, for showing a model's performance in front of the camera, for showing a scientific or other happening which cannot be repeated over and over or which may be too fast, too slow, too dangerous or too far away to be studied by the naked eye.

Instant film material allows you to show to an entire group things which normally can be seen by one person only, such as a view through a microscope. Other valuable applications are for showing a client or an art director a layout with actual images instead of sketches. The film can be used to make photographic instead of pencil notes in the classroom, which is especially valuable when time-consuming sketches would be involved.

Polaroid magazines for Hasselblad

Two magazines for Polaroid film can be adapted to Hasselblad cameras allowing the use of all important Polaroid emulsions. The magazine 80 is made for the 'amateur' films Polacolor 88 and black-and-white 87. These emulsions serve the amateur purpose well, when used simply for the purpose of having an instant picture. Since they are less expensive than the 'professional' films, the magazine 80 is the logical choice for photographers who like to use the Hasselblad occasionally as an instant camera rather than for producing accurate test shots. The magazine 80 can be used on 5000C/M, EL/M and SWC/M cameras, and on the Superwide C after making a slight modification on the camera. The protruding glass plate of the magazine 80 prevents its use on the 2000FC model.

The magazine 100 is made for the 'professional' 100 and the 600 series films which are more expensive but are the preferred emulsions for instant film test exposures, especially in professional photography. The magazine 100 can be used on 500C/M, 500EL/M, 2000FC, SWC/M and on Superwide C after a slight modification to the camera. Neither magazine is usable on the 1000F or 1600F. The image size obtained with both Polaroid magazines is the 54 × 54 mm square, identical to the size obtained on the regular 120, 220 or 70 mm magazines. The image therefore covers only part of the larger Polaroid sheet films. Both magazines have glass plates in front of the film plane, which move the image formed by the lens to the exact film plane distance. The design of the Polaroid film pack makes it impossible to bring the film plane as close to the Hasselblad camera body as the Hasselblad film magazines. The image formed by the lens falls slightly in front of the film plane and is therefore slightly out of focus on the film. Shortening the distance mechanically is not possible, but *lengthening* the distance optically is possible. The glass plate refracts light rays so the image distance becomes longer and the image is formed exactly where the film is.

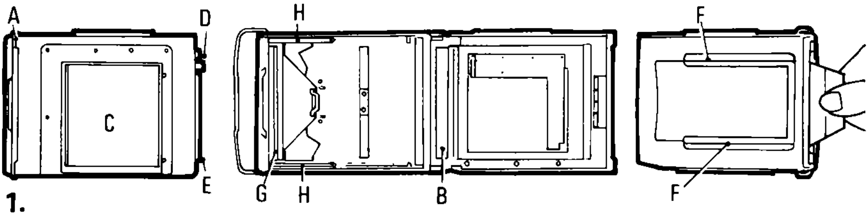
Since the glass plate is right in front of the film plane, any dirt and dust particles will show up in the image. It is, therefore, necessary to keep it spotlessly clean. Being glass, it can be cleaned like lens surfaces.

Both Polaroid magazines attach to the Hasselblad camera body exactly like all the other film magazines, and are removed the same way. Just like the other magazines, they come with a darkslide which must be inserted before the magazine can be removed and must be in the magazine when it is off the camera to protect the film from light. Exposures with the Polaroid backs can only be made with the dark slide removed. When the magazine is not in use, the glass plate should be protected by the safety cover.

Polaroid magazines on the Superwide

The magazines for Polaroid film cannot be attached to Superwide cameras made before 1980 because the film advance crank protrudes slightly beyond the camera/magazine separation and prevents the Polaroid magazine from laying flat against the camera body, and also because the tripod mounting plate at the bottom of the camera makes it impossible to push the Polaroid magazine completely down into the support catches so the camera latches match with the magazine.

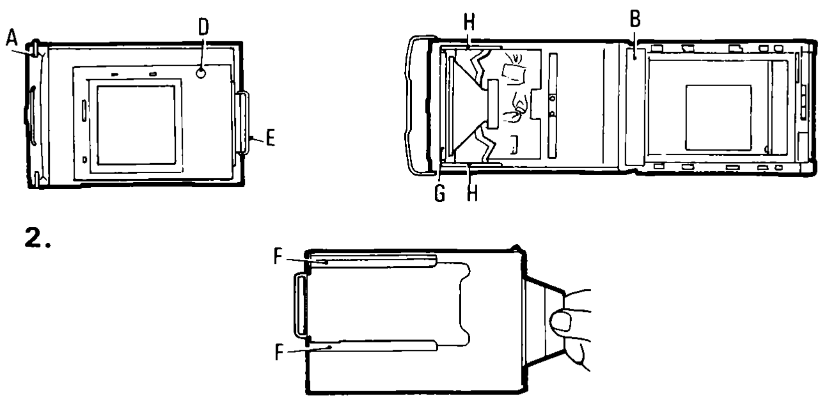
The SWC/M introduced in 1980 has been modified to allow the use of the Polaroid magazines. The new models can be distinguished by a shim underneath the tripod attachment plate bringing the plate further down to clear the bottom of the Polaroid back. The new models also have a black shim underneath the viewfinder shoe to raise the finder so it clears the top of the magazines. Viewing with the Polaroid magazine attached is therefore possible. The new cameras also have a new winding crank which not only



1.

The Polaroid magazines 80 (**1**) or 100 (**2**) are attached to the camera and removed by depressing the catch (D). They can be loaded on or off the camera.

To load the magazines open the lid by releasing the clamp (A). Push the film pack with the film towards the glass plate at an angle completely under the flange (B) on the hinged end of the magazine and push it down so that it snaps in place. Close the lid, making certain that all the white tabs are free and not caught between film pack and magazine. Pull the black safety cover all the way out of the camera. The film pack is ready for the first picture.



2.

After exposure, grip the centre of the white tab and pull it all the way out. A yellow tab will appear. Pull the yellow tab all the way out of camera at a moderate speed and without stopping. If it is not pulled out straight, some of the picture area may not develop. Developing time starts now. After the recommended developing time, quickly separate the positive from the negative starting at the end nearest the tab. Avoid contact with the developer chemicals. Fold the negative, moist side in, and dispose of it properly. The film magazine is ready for next exposure.

The darkslide can be stored in the holder (F).

Magazine 80 has a safety cover which is removed from or attached to magazine by pushing the catch (D).

The developer spreader should be cleaned frequently with a moist cloth. To remove it, lift the two rear arms (H) diagonally upwards at the same time. Press the arms down simultaneously when replacing the spreader.

clears the magazine but also allows the film to be advanced without removing the magazine. This is accomplished with a ratched type gear drive. Older models can be modified in identical fashion at a Hasselblad service centre.

Adjusting for film sensitivities

In the majority of cases, the negative or transparency film used for the final image will have a different exposure index than the instant film material used for the test. For correct exposure, therefore, something must be adjusted. The following possibilities exist:

1. *Change shutter speed*, to be done only when the shutter speed is not a deciding factor in creating the image. For blurred motion effects, the same shutter speed that produced the proper results on the test shot must be used.
2. *Change aperture.* Recommended when the shutter speed cannot be changed and/or when depth of field is not the deciding factor.
3. *Use neutral density filters* either when making the test shots or when making the final shots, depending on which film has the higher sensitivity. The use of such filters allows identical lens settings with any combination of films.

The amount of correction necessary is shown on the chart below, which is based on an instant film sensitivity of 70–80 ASA, 19 DIN, the most common film used for test shots.

EXPOSURE CORRECTIONS OF 70–75 ASA POLAROID FILM FOR FINAL FILM

Final film		Change in	Multiply shutter	
ASA	DIN	aperture	speed	Use neutral density filters
25	15	Open 1½ stops	¼ ×	0.50 (Gr2) with instant film
40	17	Open 1 stop	½ ×	0.30 (Gr2) with instant film
50	18	Open ½ stop	2/3 ×	0.10 (Gr2) with instant film
64	19	None	1	None
100	21	Close ½ stop	1.5 ×	0.10 with final film
125	22	Close 1 stop	2 ×	0.30 with final film
160	23	Close 1 stop	2 ×	0.30 with final film
200	24	Close 2 stops	3 ×	0.60 (Gr2) with final film
400	27	Close 2½ stops	6 ×	0.60 (Gr2) with final film
800	30	Close 3½ stops	10 ×	0.90 (Gr3) with final film

Shutter speeds are multiplied as follows:
Original shutter speed 1/125 sec
2 × : 1/125 × 2 = 2/125 = 1/60 sec
½ × : 1/125 × ½ = 1/250 sec

The Hasselblad camera can be used for Polaroid test shots even if the final pictures are made with another camera for which the film or the accessory to

hold the film is not available, e.g. 4×5 in or 35 mm format. It is then only necessary to transfer the lens and camera settings to the other camera and use a focal length lens that produces an identical or similar image on the other format. (See lens focal length conversion chart p. 150.)

Care of film and magazine

Once a film pack is unwrapped, protect it from bright light; if possible, keep it in a closed box to guard against light leakage. When handling film packs during loading, be careful not to press against the centre of the pack at any time as this may damage the film. Hold the film pack only by its edges at all times.

The Polaroid Land film process uses a caustic jelly, which is safely packed inside sealed containers within the film packet. If you should accidentally get some of this jelly on your skin, wipe it off immediately and, to avoid an alkali burn, wash the area with plenty of water as soon as possible. It is particularly important to keep the jelly away from eyes and mouth. Keep the discarded materials, which still contain some jelly, out of the reach of children and animals, and out of contact with clothing and furniture. There is usually some leakage of jelly inside the film pack which can cause problems. It is, therefore, important to keep the rollers of the developer spreader clean. They should be checked and cleaned frequently, preferably after every film pack.

Developing temperature

Polaroid films may be exposed successfully at any temperature, but the temperature of the film and film holder at the time of processing has an effect on the picture. The ideal processing temperature is 24°C (75°F) for all Polaroid materials but satisfactory results can be obtained when it is warmer or cooler. For critical results on Polacolor Professional film, the 24°C (75°F) temperature should be maintained whenever possible.

Acceptable results with this film may be obtained at 16–38°C (60–100°F), but the processing temperature affects both the effective film speed and the colour balance, so that some correction may be necessary. When film is to be processed at 16°C (60°F), increase exposure by about one half an *f* stop. If prints have weak tones and a reddish tint, extend the processing time by 10–20 sec, for better results. When film is to be processed at 38°C (100°F), decrease exposure by about one half an *f* stop; in addition, magenta filtration may be required.

Overextended processing will yield richer, more saturated colours and deeper blacks. Also, the print may adopt a slight blue-green colour bias, requiring warming filtration. Use of a CR decamired or 81 Wratten filter is suggested.

Reciprocity law failure

When light reaching the film is of low intensity or of very short duration, 'reciprocity law failure' will occur. To correct for it, the normal indicated exposure should be increased. The colour balance generally also needs correction. The following table shows the approximate correction needed over a range of indicated exposure times, in daylight or with electronic flash.

APPROXIMATE CORRECTIONS FOR RECIPROCITY LAW FAILURE

Indicated exposure (sec)	1/1000	1/100	1/10	1	10	100
CC filter	None or 05C	None	05R + 05Y	10R + 20Y	30R + 20Y	30R + 20Y
Exposure increase	None	None	1/3 *f*-stop	$1\frac{1}{2}$ *f*-stop	$2\frac{1}{2}$ *f*-stop	3 *f*-stop

Flash of very short duration (less than 1/1000 sec), as is given by some automatic electronic flash units at normal portraiture range, will cause a further shift in colour balance. You can generally avoid this by setting the flash unit for 'manual' operation.

Polaroid B/W in bright light

The 3000 ASA or 36 DIN exposure index of the Polaroid black-and-white films is of great advantage when used in available light situations. It is generally too fast for use in daylight, with studio lights or electronic flash. Neutral density filters, however, can be used to reduce the sensitivity as follows:

Filter type	Density	Film sensitivity ASA	Film sensitivity DIN
Gr 2	0.6	800	30
Gr 3	0.8	400	27
Gr 6	1.8	50	18

Care of prints

Some Polaroid films need coating, others do not. In either case, do not touch the face of the print after separation from the negative, until it dries to a hard gloss. Polaroid colour prints have good colour stability but as with all colours and any type of colour film, prints should not be subjected to prolonged exposure to strong light, which can produce premature fading.

Professional films for Magazine 100

Polacolor Type 668.
Equivalent to 75 ASA, 20 DIN.
Balanced for 5500 K or DM 18 (daylight and electronic flash).
Developing time: 60 sec.

Most light sources other than average daylight or electronic flash will require special filtration. In general, the basic rules for filtration are the same as those for wet-process colour films that are balanced for daylight.

Type 667, black-and-white.
Equivalent to 3000 ASA or 36 DIN.
Developing time: 30 sec.

Pictures are completely finished as soon as they are away from the negative. Prints do not require coating.

Type 665 positive/negative black-and-white.
Equivalent to 75 ASA or 20 DIN.

A professional film which produces prints and negatives simultaneously. Both develop on the spot and no darkroom is needed. It allows instant viewing of the results on a print and at the same time gives a negative which can be used to make high quality enlargements the standard way on regular enlarging papers.

Amateur films for Magazine 100

These instant films have characteristics similar to the professional types but are manufactured to meet the requirements and standards of the photographer who uses instant films for amateur applications or occasional testing rather than critical tests and scientific applications. The film packs and film sizes are identical to the professional types.

Polacolor Type 108.
Equivalent to 70 ASA, 20 DIN.
Balanced for 5500 K–DM 18 (daylight and electronic flash).
Developing time: 60 sec.

Type 107, black-and-white.
Equivalent to 3000 ASA, 36 DIN.
Developing time: 15 sec.

Has a somewhat narrower tonal range than the professional Type 667. The film requires coating of the final image.

Polacolor Type 88.
Equivalent to 75 ASA, 20 DIN.
Colour film balanced for 5500°K–DM 18 and therefore made for colour pictures in daylight or with electronic flash.
Developing time: 60 sec.

Type 87, black-and-white.
Equivalent to 3000 ASA, 36 DIN.
Developing time: 30 sec.
Black-and-white film for instant images in existing light.

17

Close-ups

HASSELBLAD LENSES CAN be focused down to certain minimum distances which vary from 30 cm (12 in) on the 38 mm Biogon to 8.5 m (28 ft) on the 500 mm Tele-Tessar. They can be used closer in combination with close-up accessories, such as close-up or Proxar lenses, extension tubes and extension bellows. The choice of accessory depends mainly on the size of the area to be covered, i.e. the magnification.

Choice of lens

Close-up accessories simply make it possible to take pictures from a closer distance. The lenses behave exactly as they do at longer distances, and everything said in the chapter on lenses applies.

The camera-to-subject distance determines the perspective. Different focal length lenses cover different background areas even if the main subject is recorded at an identical size. Longer focal length lenses blur backgrounds more than shorter ones. Different focal length lenses can cover the same area from different distances.

Working on a copy stand, a shorter lens is preferable or necessary to keep the camera on the steadier lower end of the camera post, while some subjects, such as surgery, timid insects, or dangerous activities like welding, call for a longer shooting distance and thus a longer focal length lens.

All Hasselblad lenses 80 mm and longer are good close-up lenses. Lenses of shorter focal length should not be used except for special purposes or effects. I have used the 30 mm fisheye with a short extension tube.

Magnification

Magnification indicates how much larger (or smaller) a subject is recorded on the film; it is the ratio in size between the actual subject and its image recorded

on the film. You can measure the image on the focusing screen after sliding off the viewfinder. A more practical way is to base it on the area coverage. We know the dimension of the film format—55 mm for both sides of the $2\frac{1}{4}$ in square or the longer side of $4\frac{1}{2} \times 6$ cm, or 40 mm for superslides and the shorter side of $4\frac{1}{2} \times 6$ cm. You can calculate magnification simply by dividing the negative side into the width or length of the area covered. If you can cover an area 220 mm wide, the magnification is $55 \div 220 = 0.25$ or 1 :4.

Lifesize or 1 :1 magnification exists when the area that we cover is equal to the film format, 55×55 mm for the $2\frac{1}{4}$ in square. It is more than life size when a smaller area is covered on a larger format, for instance when filling the $2\frac{1}{4}$ in negative with a small 27 mm square area, the magnification is $55 \div 27 = 2$ or 2:1.

Proxar or close-up lenses

Proxar or close-up lenses are positive lenses which are mounted in front of the camera lens like a filter and they should be as near the front element as possible. Proxars can be used with almost any focal length lens and also with zoom lenses.

The Hasselblad Proxars come in focal lengths of 0.5 m, 1.0 m and 2.0 m and are engraved accordingly. Many other manufacturers indicate the strength of their close-up lenses in dioptre power like eyeglass lenses. Dioptre is just another way of expressing the focal length of a lens.

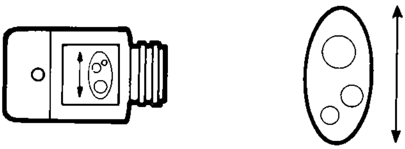
Dioptre strength is simply the focal length in metres divided into 1 m. Thus the Hasselblad lenses have the following dioptre powers: 2 m $= \frac{1}{2}$ dioptre, 1 m = 1 dioptre, and 0.5 m = 2 dioptre. The dioptre power or focal length determines the subject distance at which the lens produces sharp images. With the lens on the camera set at infinity, a close-up lens always produces a sharp image when the subject distance, measured from the close-up lens, is equal to the focal length of the close-up lens.

The following distances thus apply:

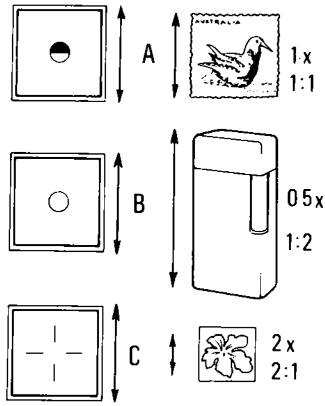
Focal length of close-up lens	Dioptre power	Subject distance*	
2 m	+0.5	79 in	2 m
1 m	+1	$39\frac{1}{2}$ in	1 m
0.5 m	+2	$19\frac{3}{4}$ in	0.5 m
0.33 m	+3	13 in	0.33 m
0.25 m	+4	10 in	0.25 m

*Subject distances in this case are measured from the close-up lens not from the film plane as normally.

While the above distances apply for infinity setting, the focusing ring on the lens need not be at infinity but focused over a shorter range.

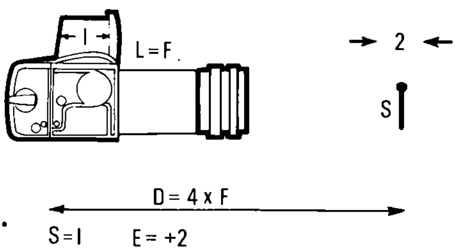


1.



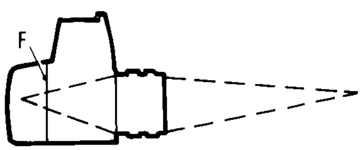
2.

1 Magnification is the relationship between the size of actual subject and the size of its image as recorded on the film or seen on the ground glass screen of the camera.
2 As the size of the subject is usually known in close-up photography, magnification can be determined quickly by relating the subject size to negative size. For example, if the subject is about the same size as the negative, we have 1:1 magnification (A); when the subject is twice as large (B), we have 0.5 or 1:2 magnification; and, when we fill the negative with a small subject half as large as the negative (C), we have 2 × or 2:1 magnification.



3.

Life-size magnification is always obtained when the length of the extension tube or bellows (L) is equal to the focal length (F) of the lens (L = F). The distance from the subject to the film plane, D, is equal to 4 × the focal length, i.e. D = 4 × F. The exposure increase (E) is always two *f* stops and the depth of field at *f* 11 is about 2 mm.



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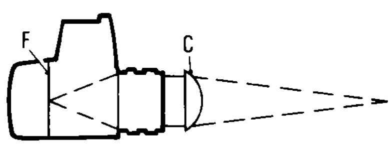


5.

4 A subject that is closer to the lens than the minimum focusing distance of the lens forms its image behind the film plane (F). **5** The addition of a Proxar lens (C) can bring the image onto the film plane.

Since adding a close-up lens means adding a lens element to a well corrected camera lens, quality on the edges suffers somewhat, depending on the power of the Proxar. Stopping down two to three *f* stops can restore the quality. With lenses up to 0.5 m (+2 dioptres), the loss of quality is hardly ever noticeable at the small apertures normally used in close-up work.

You can combine two Proxar lenses. The power of the combination is obtained by adding the two dioptre strengths. For example, a +1 and +2 close-up lens adds up to a +3 dioptre lens with a focal length of 33 cm (13 in). It is recommended to place the more powerful lens (highest dioptre rating, shortest focal length) closest to the camera lens.

Close-up lenses do not alter the exposure, you can use the lens settings obtained from your normal exposure meter.

Proxars are the easiest of the close-up accessories to use, but they are meant only for low magnification work, i.e. when it is necessary to go just a little closer than the focusing range of the lens. Strong close-up lenses (+4 to +10 dioptres) could be used for higher magnifications, but with an obvious loss of quality.

Partial close-up lenses

You can use your Hasselblad also with a close-up lens that does not cover the entire area but only part, usually one half. These types of lens are referred to as split field or bifocal lenses. They produce two different planes of focus—one at long distances, one close by. This opens up interesting possibilities—a sharp image of something very close to the camera and at the same time of something far away which could never be bridged by the depth of field.

The camera lens is set for the distance of the far subject. The close-up lens determines the distance of the close subject. This is for instance 50 cm ($19\frac{3}{4}$ in) for a +2 dioptre lens with the camera lens set at infinity. Two completely separate images are formed: a close-up image with its depth of field, and a distant one with its own depth of field. Anything that is in between is out of focus and looks unnatural if it is obvious. It is therefore important to avoid such obviously blurred areas by careful framing and selection of camera angle. Frame the image so that areas that logically continue from fore to background, such as a field, a street, a fence, are invisible.

Partial close-up lenses have valuable applications in many special fields of photography, for instance when it is necessary to include data such as a number, a name, a time clock, a date, a title, or an instrument dial in the negative or transparency. The board with the data is photographed through the close-up lens, the rest of the image through the clear area. Even small data can be shown on the image in a large way if a strong close-up lens is used. Naturally lighting for both must be equal so both are properly exposed on the film.

Extension tubes and bellows

Extension tubes and extension bellows are physically different, but serve the same purpose in close-up photography. Both accessories are mounted between camera and lens to move the lens further away from the film plane, and they are therefore an 'extension' of the focusing ring. There are no additional optical components, just an increase in the lens-to-film distance. The longer the tube or bellows with any particular focal length lens, the closer you can photograph and consequently the higher the magnification.

The same extension tube or extension on the bellows gives different magnification with different focal length lenses: a higher magnification with shorter lenses, a lower magnification with longer ones. The necessary extension length with various lenses can be found on the charts included with the accessories. You can, however, also easily determine the requirements from the following formula:

$$\text{length of extension} = \text{focal length of lens} \times \text{magnification}$$

For example, the extension necessary to obtain 0.5 × magnification with an 80 mm lens is $80 \times 0.5 = 40$ mm; and with a 120 mm lens, $120 \times 0.5 = 60$ mm. Knowing this relationship is valuable as it eliminates time-consuming experimenting, moving cameras, adding and changing lenses and accessories to find out what area is covered.

From the same formula, you can easily determine the magnification:

$$\text{magnification} = \frac{\text{length of extension}}{\text{focal length of lens}}$$

For example, a 55 mm extension tube on a 120 mm lens will give a magnification of $55 \div 120 = 0.46$.

Naturally, with the lens set away from its infinity position, the distance the lens has been moved forward should be added to the length of the extension for really accurate calculations.

Photographing subjects life-size

A subject is recorded life-size, in 1:1 magnification, when the area coverage of the subject is equal to the film format; the length of the extension needed is equal to the focal length of the lens, e.g. 80 mm with a 80 mm lens.

Adding an extension equal to focal length means increasing the lens-to-film distance (the image distance) to twice the focal length of the lens. Optical principles also tell us that 1:1 magnification is obtained when image distance equals subject distance. So, the lens-to-subject distance is also twice the focal length of the lens and, adding it up, the subject to film distance is always equal to four times the focal length of the lens, e.g. 320 mm with 80 mm lens and 480 mm with 120 mm.

Depth of field

Depth of field in close-up photography is determined only by the area coverage (magnification) and the aperture (*f*-stop) of the lens; not even the focal length of the lens influences depth of field. If tubes and bellows seem to produce less depth of field, it is not because of the accessory but because of the higher magnification. Since the area coverage or magnification is usually predetermined, depth of field can be increased or decreased only by opening or closing the aperture.

DEPTH OF FIELD AT VARIOUS MAGNIFICATIONS

Magnification	Total depth of field* in mm at *f* 11 A	 B
0.1 ×	100	50
0.2 ×	30	15
0.3 ×	15	7
0.5 ×	6	3
0.8 ×	3	1½
1 ×	2	1
1.2 ×	1.5	0.7
1.5 ×	1	0.5
2 ×	0.8	0.4
3 ×	0.4	0.2

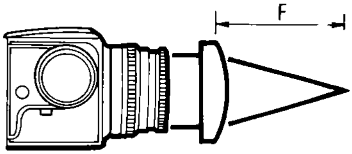
*About half of the depth of field is in front and half behind the set distance.
A: Circle of confusion 0.06 mm (1/400 in).
B: Circle of confusion 0.03 mm (1/800 in).

To determine the depth of field at other apertures, keep in mind that when you close the aperture two stops, the depth of field becomes about twice as large; by opening the aperture two stops, depth of field is cut down to about half.

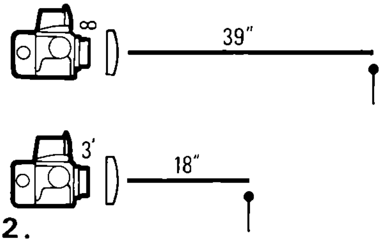
The above figures clearly indicate the limited depth of field in close-up photography and stress the importance of extreme accuracy in focusing. The sharpness beyond the limits of the depth of field falls off rapidly with a longer lens, more gradually with a shorter lens.

Exposure

Correct exposure in close-up photography is no different from photography at long distances, but you ensure that the meter reading is taken off the small area recorded on the film, sometimes even off a smaller main subject within the area. The meter prism does this and is therefore a great help. With a separate meter, it is often not so easy to hold the meter close enough to the subject without shading the subject or bumping into the camera. I suggest, therefore, that you consider a grey card reading, which gives a large area for a reflected meter reading and reflects the proper amount of light for correct exposure.

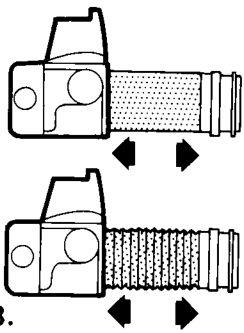


1.



2.

1 With the camera lens set at infinity, the correct distance from the close-up lens to the subject is always equal to the focal length (F) of the lens. It is possible to photograph closer subjects by setting the camera lens to a closer distance. For example (**2**), with a camera lens set to infinity and a 1 dioptre (1 m) close-up lens the subject would be 1 m (39 in) away from the camera; with the same close-up lens but with the 80 mm camera lens set to 3 ft, the subject would be 46 cm (18 in) away.



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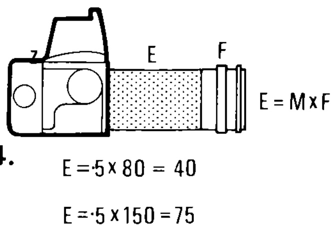
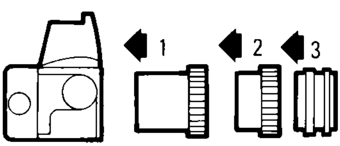


4.

3 Extension tubes and bellows extensions serve the same purpose, i.e. they move the lens further away from the film plane. An extension tube and a bellows extension extended to the same length produce the same magnification and image.
4 The necessary length of an extension tube or bellows for a particular magnification can be determined easily from the formula $E = M \times F$ where E is the length of the tube or bellows, M the magnification and F the focal length of the lens.



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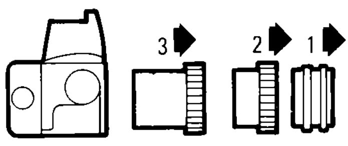


6.

5 When attaching extension tubes, start at the camera by attaching the first tube to it. Then attack the second tube to the first and finally attach the lens to the second tube.
6 To remove extension tubes, reverse the above sequence. First remove the lens from the outermost tube, then the outermost tube and finally the tube attached directly to the camera.

The grey card is a good aid with all reflected meters, even in combination with the meter prism.

The meter prism has another advantage when close-up accessories are used. The meter reading is made through the accessory, so there is no need to consider extension factors. Whatever the meter prism says should be correct regardless of what lens and close-up accessory are used.

When extension tubes or bellows are used and the meter reading is made with a separate meter, the so-called 'exposure factor' must be considered. This is necessary as the tubes and bellows move the lens further from the film plane and the light is spread over a larger area with consequently less light reaching the film.

The exposure increase is based mainly on the ratio between focal length of lens and length of extension, at least for symmetrical lenses like the Planars. Consequently, the increase can also be determined from a simple chart, as shown below, which applies to any camera as long as the lenses are of similar design to the Planars. This chart is helpful when the close-up tables are not available.

EXPOSURE INCREASES

Extension ÷ focal length	Increase in exposure in *f* stops or EVs
1/10 to 1/5	1/2
1/4 to 1/3	1
1/2	$1\frac{1}{2}$
1	2
$1\frac{1}{2}$	$2\frac{1}{2}$
2	3

For example, a 120 mm lens with bellows extension of 180 mm will need an increase in exposure of $2\frac{1}{2}$ *f* stops or $2\frac{1}{2}$ EV ($180 \div 120 = 1\frac{1}{2}$).

Reversing lenses

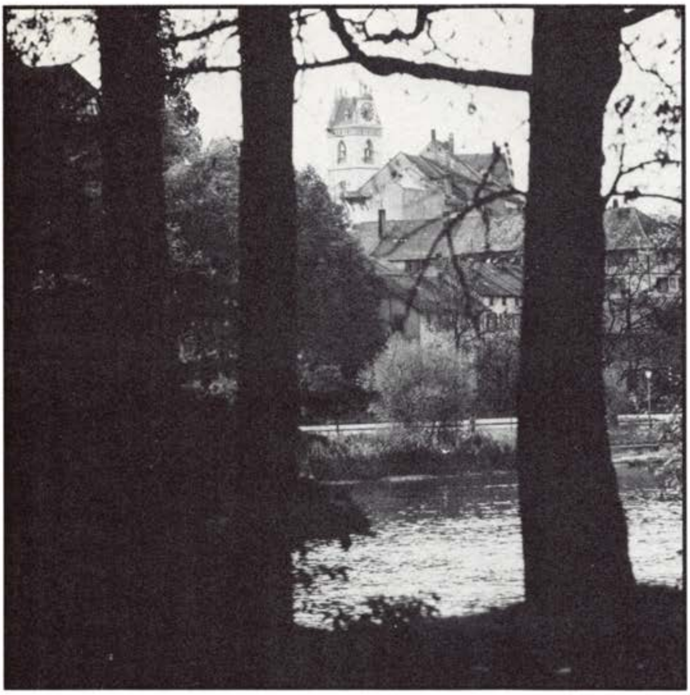
Close-up pictures are often taken with the front of the lens towards the film, the rear towards the subject, just the opposite from the way it is usually positioned. This is because when the image is larger than the object many lenses work better that way round.

Normally the subject is much further from the lens than is the film. The closer you photograph, the shorter the subject distance and the longer the image distance, until at life-size magnification they are equal. Image distances are longer than subject distances when the magnification becomes greater than 1 × and this is the only time when reversing lenses can improve the image. With the Zeiss lenses, however, the change in quality is so negligible even beyond life-size magnification that reversing lenses is not necessary in practice.

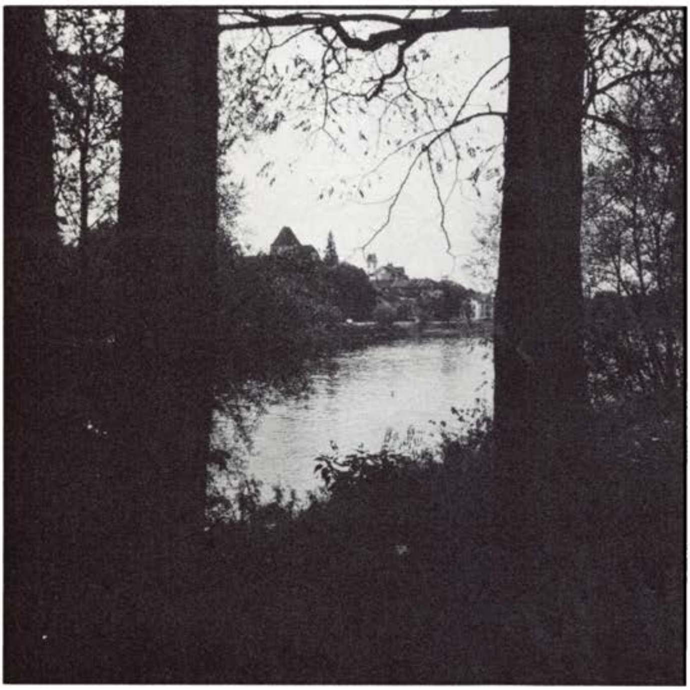
Δ *Split-screen effects are possible with the professional lens shade and a mask. The final picture is most convincing if the dividing line between the two exposures is not obvious. Here the line has been camouflaged by the edge of the tree. The division need not be vertical or exactly half-way across the frame.* Ernst Wildi.

◁*Variations in depth of field can produce quite strikingly different effects. With a large depth of field, i.e. small aperture, much of the foreground and background is in focus and even that which is not can still be identified. With a shallower depth of field, less of the area before and beyond the point focused on is sharp and the eye is therefore drawn to the main subject.* Ernst Wildi.

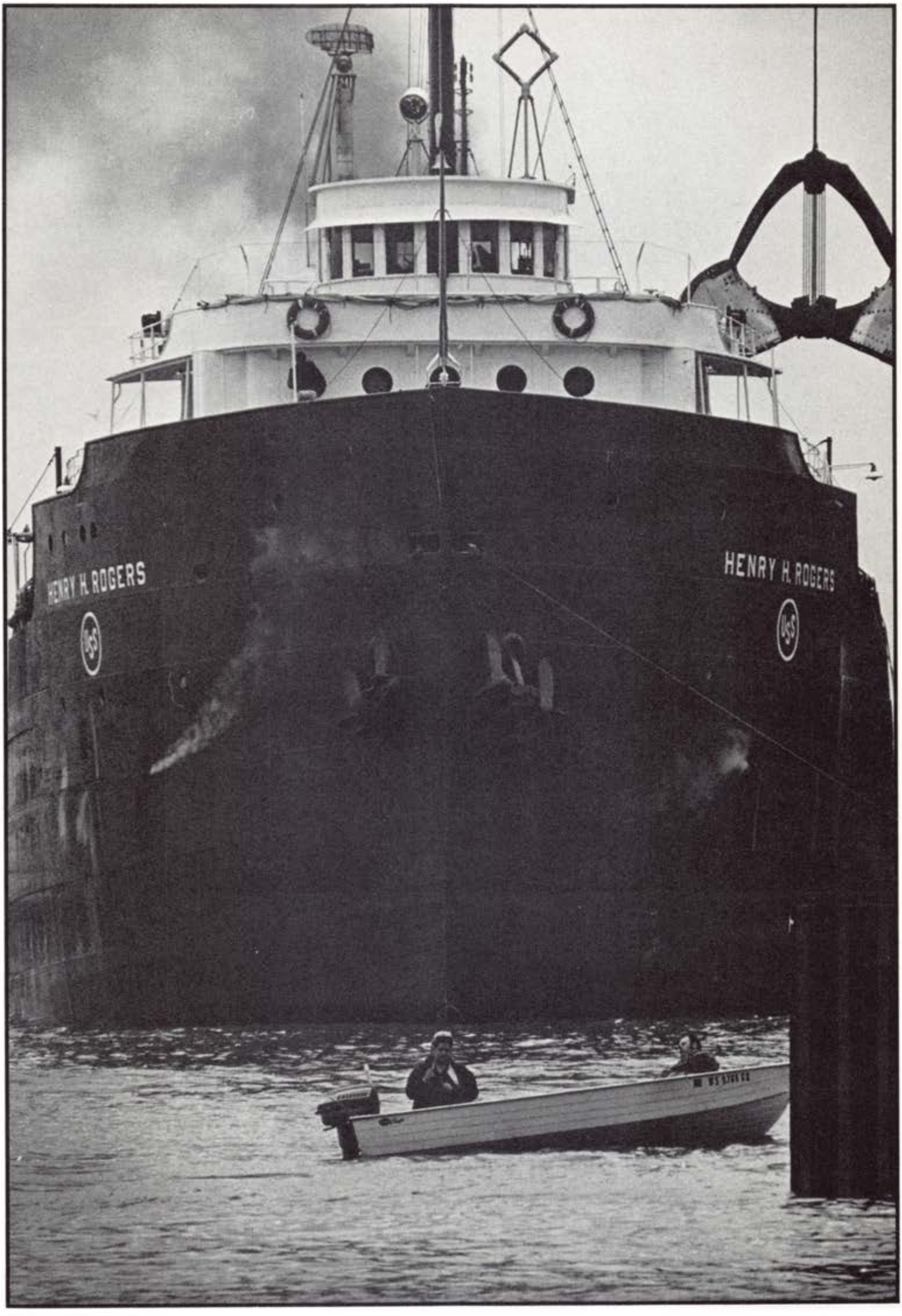
▷*In this picture, the creative use of depth of field is used powerfully, not only to focus attention on the main subject but also to strengthen the impression of a small girl surrounded by a crowd of taller children and adults. The effect is compounded by the space to both sides and beyond the girl. This type of candid shot is as easy to take with the Hasselblad as it is with 35 mm cameras.* Horace Ward.



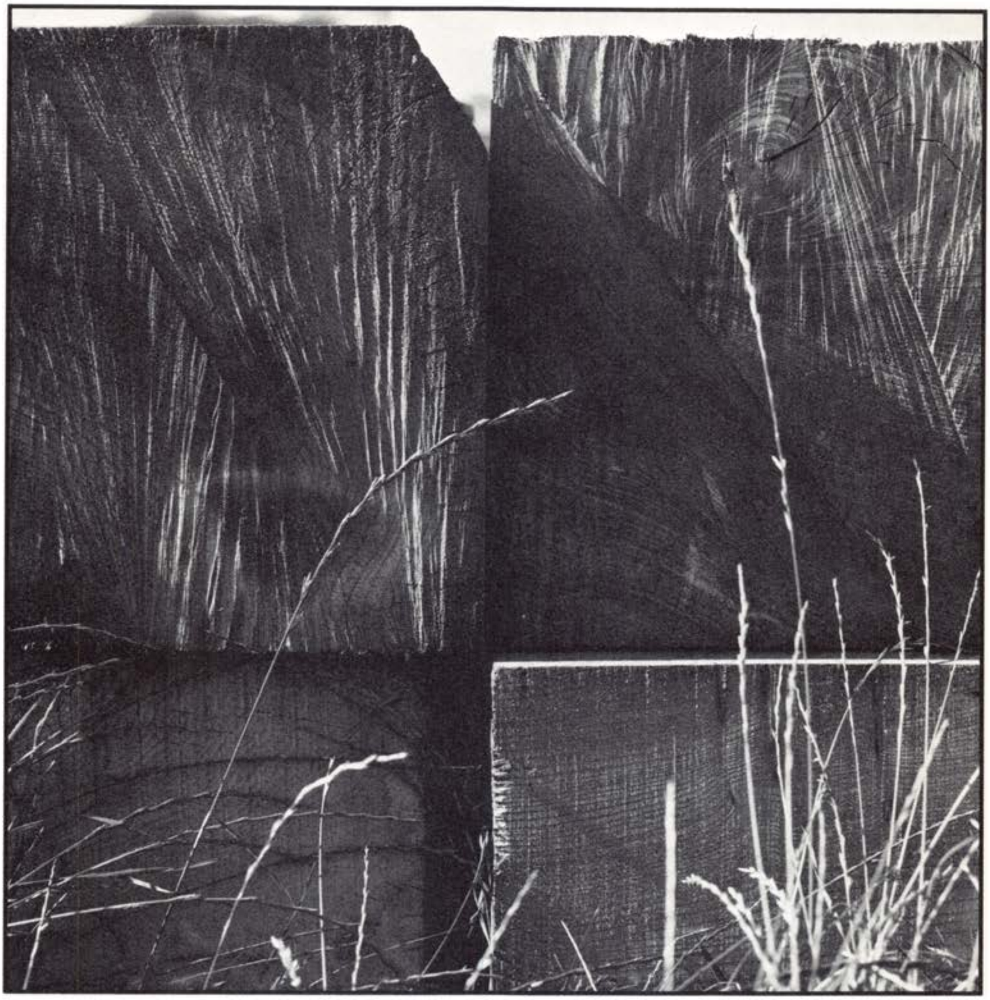
◁ *The choice of lens is an important consideration in making a particular image. In these two examples the difference between using a long focal length (top) and a wide-angle lens (bottom) is shown. In the first, the perspective appears very compressed and the details of the buildings in the town are clearly visible. The wide-angle lens gives the impression that the buildings are much farther away. Note that neither lens produces an image that corresponds with human vision.* Ernst Wildi.



▷ *Actual perspective depends entirely on subject distance but can influence the way it is rendered in a picture as is well demonstrated in this picture taken with a 500 mm Tele Tessar lens. The apparent position of the small dinghy is dangerously close to the bow of the ship and gives impact to the image. In actual fact, the two boats were some distance apart, as a normal lens would have shown.* Vern Arendt.


HENRY H. ROGERS
HENRY H. ROGERS

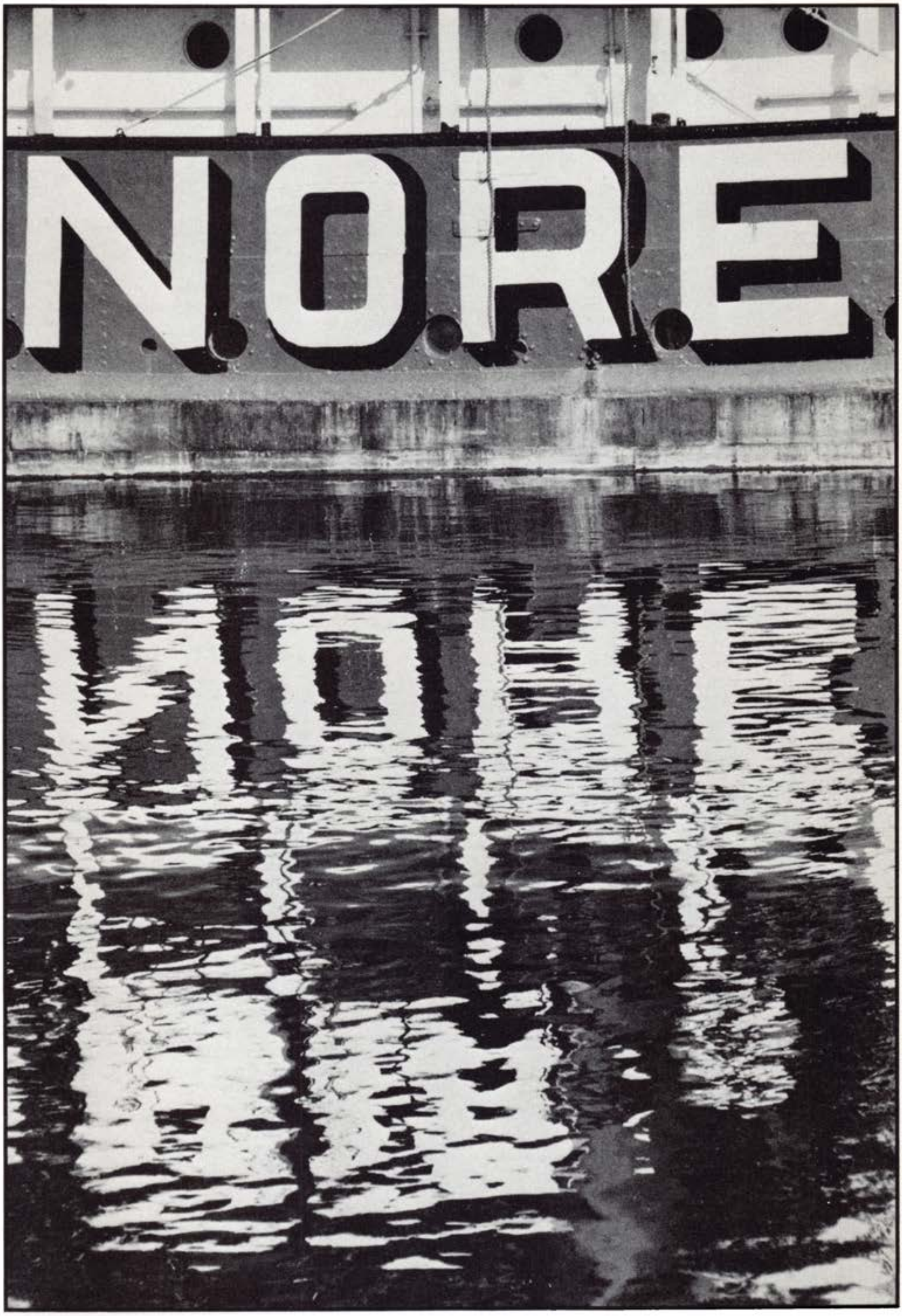
◁One of the problems photographers meet is that of recording a three-dimensional subject in a two-dimensional medium with the possible loss of structure and depth. In the bottom photograph taken out of doors on an overcast day, the subject appears flat and uninteresting. In the top photograph, the toadstool has been given shape by the use of flash as a side light. Ernst Wildi.



△*The effect of light and shadow in rendering surface texture is not only obtained artificially with flash, it also occurs in ordinary sunlight. In this picture, the light has accentuated shape and texture in a subject that would otherwise be extremely dull. Note how the square format of the Hasselblad has been used to complement the image structure.* Paul Petzold.

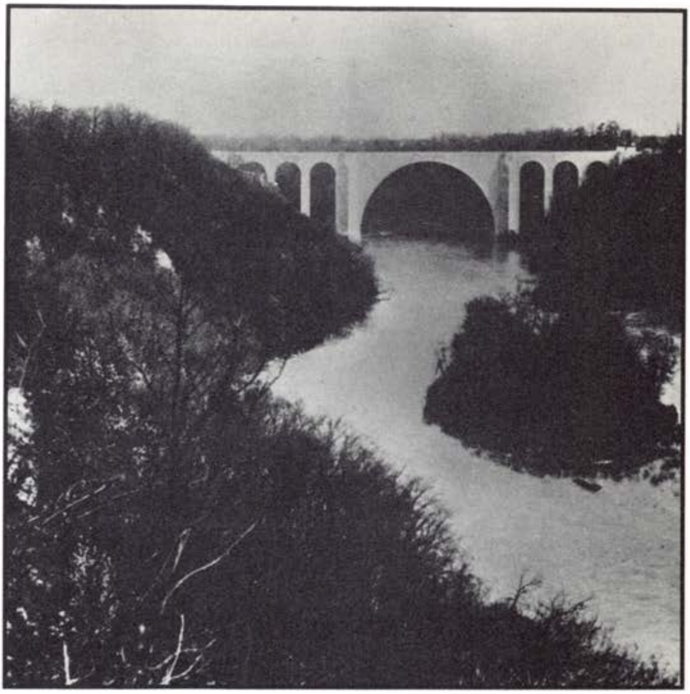
◁ *The clarity of an image may be reduced by reflections from a shiny surface such as typically encountered when photographing through glass (bottom). One way to overcome this problem is to use a polarizing screen (top). The maximum reduction of the reflections is obtained when the camera is positioned at about 35° to the reflecting surface.* Ernst Wildi.

▷ *Although in the previous photograph, the reflections marred the final image, in this one they form an integral part. In such cases the camera should be focused on the reflected image, not on the surface of the water itself, which requires a different focusing position. The reflection and the reflected subject, in this case included in the picture, are equidistant.* Horace Ward.


N.O.R.E.

◁*When paintings are photographed with ultraviolet light, repairs and retouched areas become clearly visible. The top photograph was taken in normal tungsten lighting, the bottom one by ultraviolet radiation from a blacklight tube with an UG11 filter over the lens. Restoration is clearly visible, particularly to the left and right. Such techniques are used to detect forgeries.* Ernst Wildi.

▷*While normal black-and-white films are sensitive to ultra-violet radiation, special infra-red-sensitive films must be used when photographing with a light source beyond the other end of the visible spectrum. Allowance must also be made for the different point of focus of the long wavelengths. The top photograph shows the forest and river recorded on ordinary black-and-white film. In the bottom photograph, infra-red-sensitive film was used and the foliage appears white. This is Wood's effect and depends on the absorption of red light by green plants and their reflection of infra-red.* Kodak.

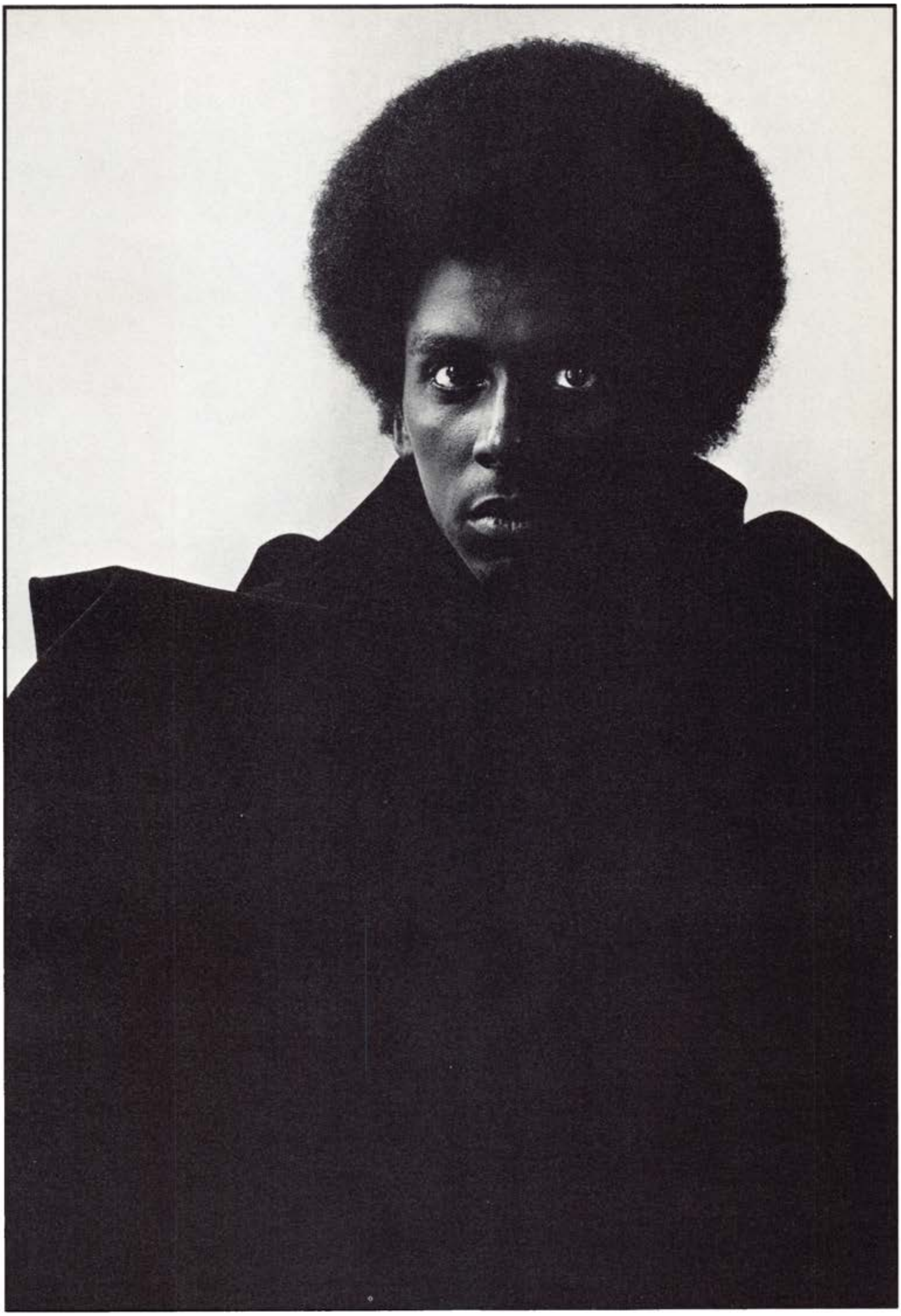


△ *Luminar lenses are specially designed to give their optimum performance at scales of reproduction in the macro and close-up range. With a bellows unit, scales of reproduction of up to 20× magnification are possible. The quality of reproduction is excellent and very useful for effects of both artistic and scientific interest. The image quality should be maintained by using a fine grain film material.* Ernst Wildi.

▷ *Although the luminar lens is designed for close-up work, acceptable results are possible at lower degrees of magnification when other lenses are used with extension tubes or bellows. This photograph of a butterfly was taken with the standard 80 mm Planar and a 21 mm extension tube. Note how shallow the depth of field is.* Paul Petzold.

△*When long focal length lenses are used, accurate focusing is very important, even at small apertures. This photograph was taken with a 500 mm Tele Tessar lens. The most important part of the subject has been recorded in focus, but the surrounding areas of the tail, back and far leg are slightly blurred.* Vern Arendt.

▷ *Intentional underexposure concentrates all tonal detail in the face alone and renders the cloak simply as a black shape. The whole figure is outlined against a featureless background which simplifies these compositional features. The outline of the head and of the cloak on both sides forces our attention to the eyes with their compelling stare.* Judy Olausen.



△ *Mountainous cloud formations on monochrome film are more striking when photographed through a red filter. The filter darkens blue sky and by contrast emphasizes the shape and shadow of the clouds themselves. The inclusion of a small area of water with the small boats and a pier makes the clouds seem even larger.* Vern Arendt.

The Hasselblad close-up charts

Instead of calculating your close-up figures, you can read them from the Hasselblad close-up charts, one of which is available for each lens. Each lens has its own chart so consult the one that corresponds to the lens you plan to use.

The chart is read from top to bottom with the various lines indicating: length of extension in inches or millimetres (the necessary length of tube or bellows); magnification; necessary close-up accessory; width of area covered; depth of field in inches or millimetres at *f* 11; necessary increase in exposure (if light is measured with a separate meter); and distance from front of lens to subject (working distance) in inches or millimetres. The close-up accessories are indicated by horizontal lines; the Proxars as P2.0, P1.0 and P0.5; the extension tubes in their corresponding lengths in millimetres; and, bellows extension as B. If close-up accessories are combined, they are added up, e.g. 55 + 21 or B + 55.

All accessories are indicated by shorter or longer horizontal lines indicating the range of the accessories; the left end corresponds to the infinity setting on the lens, the right end to the minimum distance. The dotted lines indicate the lenses with closer maximum focusing distances.

The camera in close-up work

The single-lens reflex concept with its accurate framing and focusing makes the Hasselblad 500C/M, 500EL/M and 2000FC models ideal for close-up photography.

When lenses longer than 120 mm (or shorter lenses with extension tubes or bellows) are used, a slight cut-off is visible on top of the ground-glass screen on the 500C/M and EL/M models. This is caused by the mirror which cannot be made longer. The cut off does not show on the film, so allow for it when focusing. The motor-driven 500EL/M is an advantage in close-up photography as the motor-driven film advance eliminates the danger of moving the camera which often happens when film must be advanced manually. In close-up photography even a slight movement of the camera can be very inconvenient as it may require time consuming re-setting, re-focusing, etc.

Focusing

In close-up photography, focusing is frequently much easier by moving the camera back and forth rather than turning the focusing ring until the subject is sharp on the ground glass. Try it especially with a hand-held camera. You can hold the camera with both hands in the most convenient fashion rather than holding the camera with one hand while the other is used for operating the lens.

Lenses

All extension tubes can be used with lenses 80 mm and longer, including the 350 and 500 mm focal lengths. Tubes cannot be used with zoom lenses as the image does not stay in focus; 80–250 mm lenses are used on the bellows extension. For physical reasons of rigidity, the long 350 and 500 mm lenses cannot be recommended with this accessory. Close-up lenses can be used in front of all lenses, except the fish-eye, as long as the close-up lens has a diameter at least as large as the lens. Close-up lenses larger than 50 mm must be obtained from sources other than Hasselblad.

S-Planar lenses. The two S-Planar lenses of 120 and 135 mm focal length are specially recommended for close-up work as they are optically corrected to provide best image quality at close distances. The 120 mm S-Planar is in a standard mount with shutter for use on 500C/M, 500EL/M and 2000FC cameras. To maintain the quality in close-up photography, the S-Planar lens should be used with extension tubes or bellows rather than Proxar lenses.

The 135 mm S-Planar has no focusing mount as it is intended for use with bellows extension where focusing is done by extending the bellows. The lens is in focus at infinity when the lens seat is 138.5 mm from the film plane which is at the shortest bellows extension of 63.5 mm. At the longest extension of 202 mm (8 in), it covers a $2\frac{1}{4}$ in area for life-size magnification. This combination of lens and bellows extension, therefore, can be used to cover the entire range from infinity to life-size magnification. For higher magnification, extension tubes can be mounted between bellows extension and lens, or Proxar lenses can be added to the front of the lens.

There is one way the 135 mm S-Planar can be used without the bellows, that is with extensions tubes longer than 63.5 mm (for example 55 + 21). You can then focus by moving camera closer or further until image is sharp on the ground glass. Area coverage and other data can be calculated from the chart opposite.

Short extension tubes can also be used with the Distagon wide angles but these lenses are not designed to provide best image quality at close distances although they are satisfactory when closed down.

Extension tubes

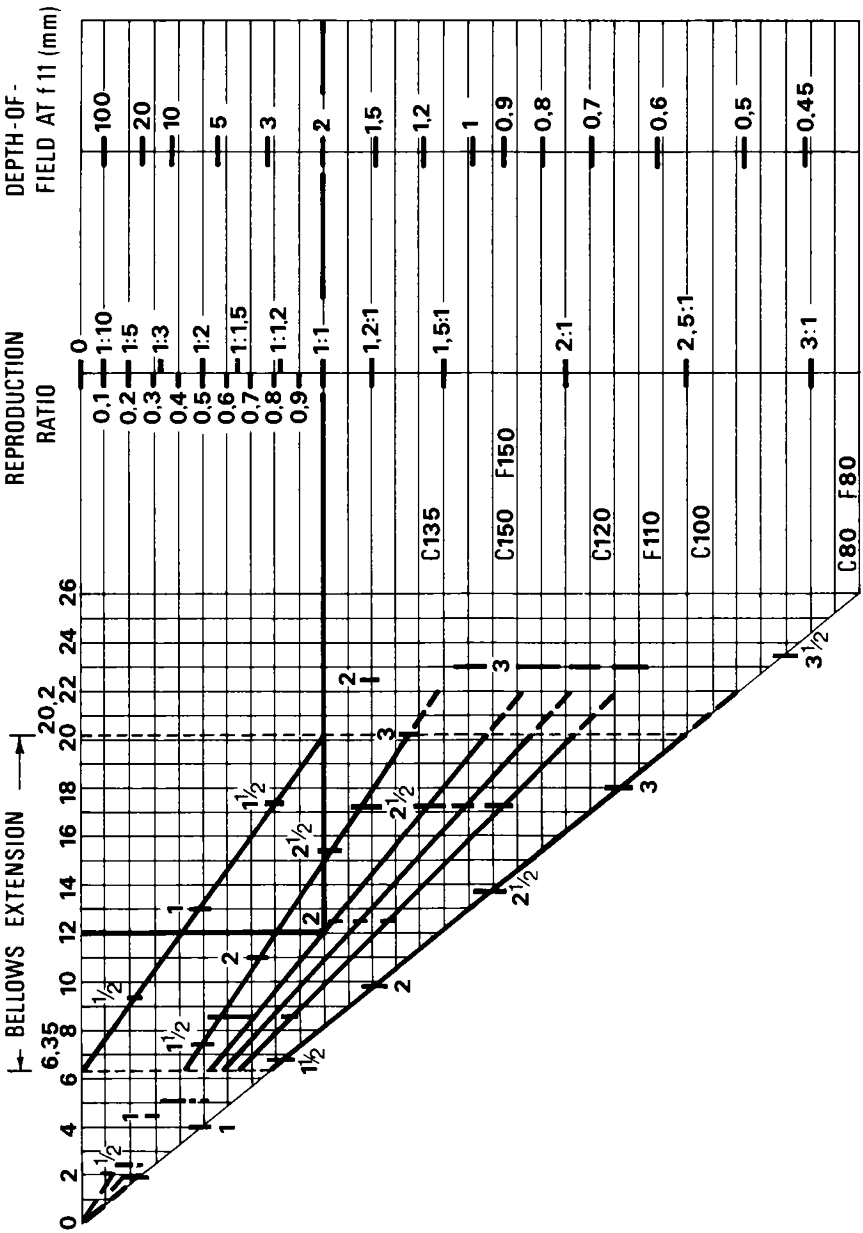
Seven extension tubes are available for Hasselblad, their designation (8, 10, 16, 21, 32, 55 and 56) refers to the length of the tube in millimetres. Each tube can be used alone or they can be combined. It is generally, however, not recommended to combine more than three tubes, as the coupling between camera and lens may not perform with utmost reliability. For longer extensions, it is better to consider the extension bellows, if necessary combined with one or two tubes.

The 16, 32, 55 and 56 mm tubes can be used on all Hasselblad SLR models—the 500C/M, EL/M and 2000FC. The 8, 10 and 21 tubes on the other

Close-up chart

See text on page 241 for details of use.

This chart applies to both automatic and non-automatic extension units. The dotted lines beyond the 20,2 extension indicate the additional focusing range obtained with the focusing mount of the lens.



hand fit only on the 500C/M and EL/M models. Their physical design interferes with the shutter speed ring on the 2000FC model. They can be used on the 2000FC, however, in combination with the 16, 32, 55 or 56 tubes. If the latter is mounted on the camera, the 8, 10 or 21 tube is mounted into the first tube.

The Hasselblad extension tubes are equipped with coupling shafts that connect camera and lens mechanism to maintain the automatic aperture close-down and shutter cocking.

Attaching and removing extension tubes

Extension tubes mount on the camera exactly like lenses which means they can be attached only when the camera body is in the ready position (film is advanced) and the shaft in the tube is in the cocked position (slot lined up with red dot). If for any reason the shaft is uncocked, turn it with a coin clockwise until it locks in position with the slot opposite the red dot. This is exactly the same procedure as cocking the shutter in a lens.

Always start by attaching the first tube to the camera, adding a second or third tube to the first, and adding the lens to the attached tube or tubes last. Never attach a tube to a lens off the camera.

Extension tubes are removed by depressing the locking button (lever on extension tube 8, 10 and 16) while camera is in cocked position. For removing, it is of utmost importance to follow the following procedure:

1. Remove the lens from the tube or tubes.
2. Remove the tube from the camera body.

If more than one tube was used, remove the tube furthest from the camera (the one that was closest to the lens) first then work towards the camera, removing each tube separately, and removing the tube in the camera body last.

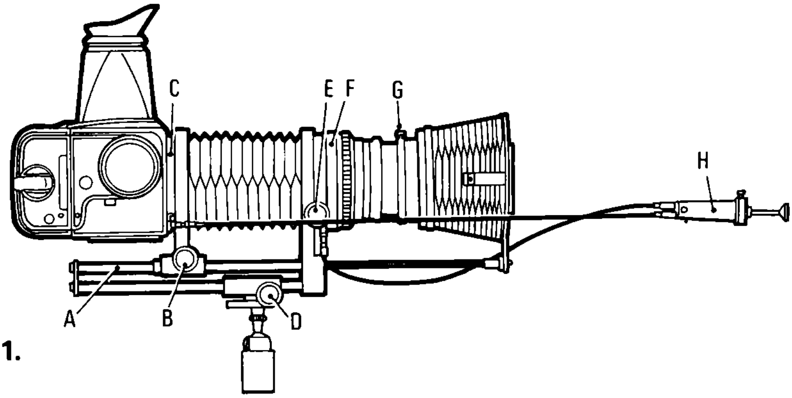
Never remove lens and tubes together from the camera. Once lens and tubes are removed from the camera body, there is no tension to prevent the shaft from rotating and it may uncock while tubes and lenses are separated. No such problem will ever occur when following the step-by-step procedure mentioned above.

Extension tubes can be attached to the front of the bellows extension. Since the rear of the 135 mm S-Planar, however, extends beyond the bayonet mount, only the tubes 21 mm and longer can be attached directly to this lens.

If you have more than one tube, I also suggest that you store each separately in the case. Do not attach them together as they might uncock when you try to take them apart.

Bellows extensions

The new automatic bellows extension has a shaft-coupling camera and lens mechanism which makes its operation identical to that of the extension tubes. Bellows and lenses are attached to and removed from the camera following the

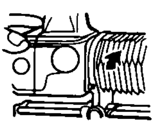


1.

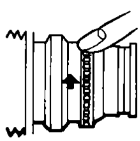
The non-automatic bellows extension unit

The components of the non-automatic bellows extension unit are: A. bellows rails; B. upper adjusting knob which changes the lens-to-film distance for focusing (the locking knob is on the other side); C. camera mount; D. lower adjusting knob which changes lens-to-subject distance (the locking knob is on the other side); E. lens shutter tensioning knob; F. lens mount; G. bellows lens hood locking screw; H. double cable release which is attached to the cable release socket on the extension unit and on the camera.

The length of each cable release stroke is adjusted by turning the threaded cable releases. Once adjusted, they are locked with set screw. The double release can be kept depressed for long time exposures with the locking screw.



2.



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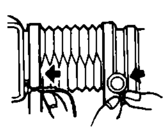

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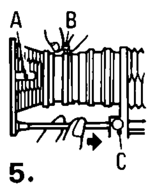


5.

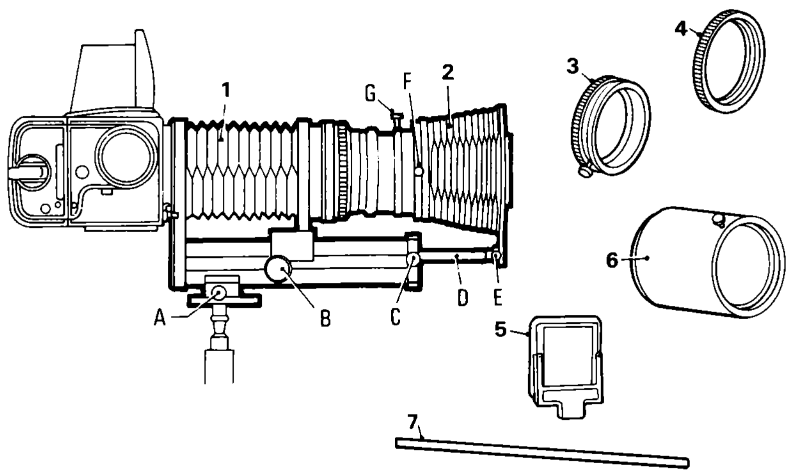
2 The bellows extension is attached to the camera like a lens by placing the two red marks opposite each other then turning the bellows closkwise (as seen from the front) until it clicks in position.
3 The lens is attached to the front of the bellows in the same way as it is attached to the camera.
4 The black end of the double cable release goes into the camera, the red end into the cable release socket in the front frame.
5 The lens shade is attached by sliding its two guide rails into the two upper openings of the front frame. Attach the rear frame to the lens, turning the bayonet ring and lock it with screw (B). Detach the two holding strips (A). Extend the bellows to the desired length and lock it in position with the knurled screw (C).

instructions for extension tubes, in other words, always remove lens from the bellows extension before removing extension bellows from camera. Never attach a lens to a bellows that is not mounted on the camera. The minimum extension is 63.5 mm (2.5 in) the maximum 202 mm (8 in).

On the non-automatic bellows extension camera and lens functions are separately operated, preferably with the use of a double cable release.

Both Hasselblad bellows extensions have a tripod socket which is used for mounting on a tripod or stand. Both also employ a double railing, one for focusing and one for moving the whole unit distance which determines magnification. With the bellows extension mounted on a tripod or stand you change and adjust the lens-to-subject distance by turning the lower knurled adjusting knob. The lens-to-film distance is changed and adjusted by turning the upper knob, which moves only the camera back and forth, leaving the lens stationary. You can actually focus in two ways: by turning the lower knob which moves lens closer to or further from the subject, in which case, the magnification changes also; or, by turning the upper knob which moves the film plane backwards, keeping the magnification constant.

The automatic bellows extension is made with the rear flush to the camera so it works on all three single-lens reflex models, the 500C/M, 500EL/M and



The automatic bellows extension

The components of the automatic bellows extension unit are: 1. the bellows extension; 2. the lens shade with support rods; 3. lens mounting ring for lenses with the 50 mm bayonet mount; 4. lens mounting ring for lenses with the 70 mm mount; 5. transparency copy holder; 6. repro tube for extending the distance between the lens and the front of the lens shader (used for duplicating slides with the 135 mm lens); and, 7. the long support rod which is necessary when the repro tube is used.

The controls of the unit are: A. locking knobs for lower adjusting knob (on other side) which changes the lens-to-subject distance; B. upper adjusting knob which changes the lens-to-film distance, the locking knob is on the other side; C. locking screw for lens shade; D. support rod for lens shade; E. screw for locking the lens shade on the support rod; F. lens hood locking screw; and, G. locking screw on lens mounting ring.

2000FC, without any modification. The coupling shaft assures camera and lens synchronization on all Hasselblad cameras and with all lenses, those with shutters and those without. The cameras are, therefore, used as they are without the close-up accessory. A double cable release is not necessary.

On the non-automatic bellows extension the rails interfere with the motor compartment of the 500EL/M. As delivered from the factory, it is therefore usable only on the 500C/M and 2000FC. The same bellows, however, can be used on the EL after rotating the rear section 90° so the rail falls on the side. The bellows extension is attached to the tripod in the usual fashion. With the tripod head straight up, ground-glass viewing must be done from the side as the camera is now laying sideways. If this is found inconvenient, tilt the tripod head 90° to the side, so the camera ground glass is again on top.

Synchronizing camera and lens

When the non-automatic bellows is used on the 500C/M or 500EL/M you must adjust the double cable release so the various camera and lens functions follow this sequence:

1. Lens shutter closes and diaphragm stops down to pre-set aperture.
2. Mirror moves up and rear curtain opens.
3. Shutter opens and closes at the set shutter speed.

First, attach the chrome end (end without red band) to the cable release socket on camera. To do this on the EL model, the release adapter must be attached to one of the openings in the front of the camera. The cable release can now be attached to the threaded end of the adapter. The camera mechanism should be cocked when doing this.

Attach the red end of the cable release to the cable release socket with red dot at the front bayonet mount of the bellows extension. The mechanism should be wound when doing this. Very slowly depress the cable release button while watching the camera and lens functions through the rear of the camera (after having removed the film magazine).

The first operation to take place is the closing of the between-lens shutter. If the shutter is closed, continue pressing the release very slowly. The mirror should lift and then the rear curtain open while the shutter in the lens remains closed. Press the release as far as it will go, which will open and close the lens shutter at the set shutter speed. While watching the shutter, also check that the diaphragm has closed to the pre-set aperture. When the finger is removed from the release, the rear curtain should close. On the 500EL, the film should also advance and the camera made ready for the next picture. The lens shutter must be re-cocked by turning the knurled knob on the front of the bellows. Advance the film in the 500C/M by turning the winding knob or crank.

If the camera and lens functions do not operate in the sequence described above, adjust the double cable release so that one of the two releases starts earlier. This is done by loosening the set screw next to the point where the

two cables come out of the release control. Each of the two cables can then be screwed in and out of the adapter which in turn changes the timing of the strokes.

If the rear curtain opened before the shutter in the lens closed down, the release going into the camera starts too early, the one going into the lens too late; it is adjusted by moving the red cable deeper into the release adapter, the chrome cable less. If the shutter in the lens opens and closes before the rear curtain is fully open, the red cable release going into the lens starts too early, the one going into the camera too late.

When the double cable release is properly adjusted, lock the set screw. Once adjusted, it should remain that way, provided the cables are always attached the same way: the red to the lens, the chrome to the camera. When pictures are made, the double cable release can be depressed at normal speed; it need not be done at the slow rate necessary for adjustment purposes. Slow releasing, and especially pausing for a moment after the mirror is lifted and the rear curtain opened, is recommended to eliminate the danger of camera motion.

If for some reason a double cable release is not available, the 500C/M and EL cameras can be operated as follows with the bellows extension.

500C/M

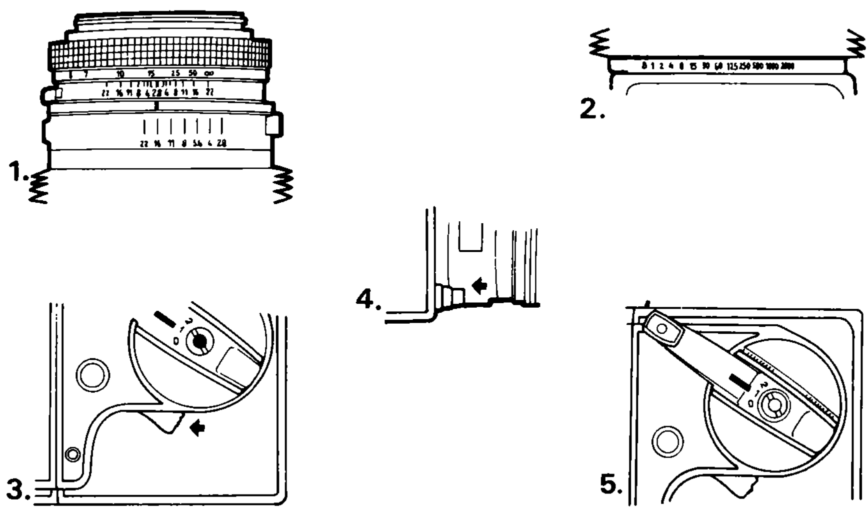
1. Close the shutter and set the diaphragm to the pre-set aperture by depressing the lens release halfway with the regular cable release, straightened paper clip, etc.
2. Lift the mirror and open the rear curtain by putting release lock on T and depressing the camera release.
3. Make the exposure by depressing lens release completely with the cable release or a paper clip.
4. Set the release lock to O, turn the winding crank to advance film and re-cock the lens shutter by turning the knurled knob.

500EL/M

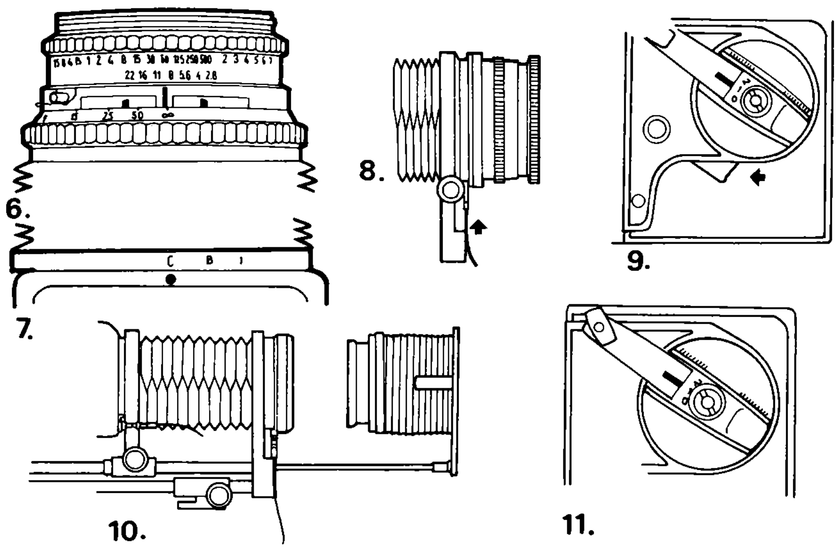
1. Close the shutter and set the diaphragm at the pre-set aperture by depressing the lens release halfway with the regular cable release or a paper clip.
2. Lift the mirror and open the rear curtain by setting the time and charging lever to T.
3. Make the exposure by depressing the lens release completely.
4. Advance the film by setting the time and charging lever back to O.
5. Re-cock the lens shutter by turning the knurled knob.

Non-auto bellows on the 2000FC

The focal-plane shutter of the 2000FC simplifies the use of the non-automatic bellows extension as it does not really require the use of a double cable release.



Using non-automatic bellows on the 2000FC without a double cable release.
When F lenses without shutter are used, set the aperture on the lens (**1**) and the shutter speed on the focal-plane shutter (**2**). Prerelease the camera (**3**) which closes the diaphragm to the preset aperture. Push the camera release (**4**) and wind on with the winding crank (**5**).



When the Compur shutter in C lenses is used, set the shutter speed and aperture on the lens (**6**) and set the focal-plane shutter to C (**7**). Depress the lens release half way (**8**) with either the cable release or a paper clip which closes the lens shutter and set the aperture to the preset value. Prerelease the camera (**9**) which opens the camera shutter and lifts the mirror. Depress the lens release completely (**10**) to make the exposure. Close the camera shutter by pressing the camera release, recock the lens shutter and advance the film with the winding crank (**11**).

All you must remember to do is to close the lens' diaphragm down to the desired aperture using the manual stop down of either the shutter or non-shutter lenses. The shutter speed is set on the camera and the exposure made in the normal fashion with the camera release. The pre-release can also be used, and should be used for longer shutter speeds. The setting of the shutter in C lenses makes no difference as the shutter does not operate during the entire process. The lens shutter, therefore, need not be re-cocked after the exposure.

Stopping down manual lenses is unnecessary with the double cable release and is the only advantage of using the double cable release on the 2000FC when the focal-plane shutter is used.

If the cable release is adjusted properly, the lens diaphragm should re-open fully when the finger is removed. The diaphragm must be re-cocked otherwise it will not stop down automatically in the next shot.

When C lenses with shutter are used and the shutter in the lens is to be used for exposure, for instance for flash sync up to 1/500 sec, the focal-plane shutter is set at C, the lens diaphragm and shutter at the desired settings and the double cable release is adjusted as described for the 500C/M and 500EL/M.

The various operations when using the double cable release are very easy to remember if one keeps in mind that with all camera models and lenses the following happens:

1. The aperture is pre-set (and the lens shutter closes if the lens has a shutter) by depressing lens release halfway. This operation must always be done first.
2. The mirror in the camera is lifted. The rear curtain is opened (with 2000FC set at C) by either depressing pre-release, camera release on 500C/M with lock on T or setting time and charge lever on EL/M on T.
3. The shutter in the lens opens and closes by depressing the lens release completely. The shutter in the 2000FC opens and closes by depressing the camera release.
4. The camera is made ready for next picture by: on the 500C and 2000FC cameras, depressing camera release if not done already (if pre-release has been used) and turning winding crank or knob; or on the 500EL camera, setting time and charge lever back to O.
5. The lens is always made ready for next picture by turning the knurled knob.

Hand-held photography

Working with a camera mounted on a tripod or stand when using the bellows extension is usually best. Hand-held use is, however, possible, especially with the automatic type. It is then best to pre-set the bellows extension to the desired magnification and focus by moving camera and bellows towards or away from the subject until image is sharp on the ground glass. This method is much easier and allows steadier holding of the camera than trying to focus by turning the knurled knobs.

Use of sunshades

The regular lens shades and the professional sunshade can be attached to lenses mounted on the bellows extension. You can also use the special lens shade made for the bellows extension. Its length can be adjusted like the professional lens shade. The shade on the non-automatic bellows is made to attach only to lenses with the 50 mm bayonet mount. The automatic type can be attached to 50 mm and 70 mm lenses using two different lens mounting rings. Both shades have guide rails in the front for holding the transparency copy holder.

Slide copying

There can be many reasons why you may like to have a duplicate of a slide. The most important one that comes to mind naturally is to protect against loss or damage to the original. A second reason is perhaps to have a duplicate in another size, perhaps a Superslide from a $2\frac{1}{4}$ in original. A third reason is to improve the original technically. A slightly under or overexposed slide can be copied lighter or darker to end up with a properly exposed duplicate. This correction works better with underexposed slides than overexposed ones, which lack colour in the highlights. Improvements in the colour rendition can be made by placing colour balance filters over the lens when the duplicate is made.

You can improve slides artistically by cropping, i.e. composing the duplicate differently from the original as in enlarging negatives. Slide duplicating offers almost unlimited creative possibilities such as radical changes in colours, changing colours over part of the slide by partial filtering, producing title slides, and double and multiple exposures by duping two or more slides together.

Instead of producing a slide from a slide, you can make a black-and-white or colour negative from the slide. The only difference in the procedure is the film loaded in the camera.

All this work can be done in laboratories and for quantity production this is probably the best way to go. Best quality is obtained when the slide, illuminated by transmitted light, is photographed directly.

Slide copying set-up

The most reliable and easiest-to-use slide duplicating set-up is obtained when camera, lens and slide holder are combined into one unit. Such a unit is made up by combining any one of the three Hasselblad single-lens reflex cameras with either one of the bellows extensions, the bellows extension sunshade and the transparency copy holder. The transparency copy holder has a diffusion glass to spread the light evenly over the entire surface, so no additional diffusion device is necessary between light source and slide.

Framing and focusing are done as for ordinary close-ups. Keep in mind the slight cut-off at the top of the ground glass of the 500C/M and 500EL/M models. With the non-automatic bellows extension, the 80 mm and 100 mm are the only practical lenses for this purpose. The non-automatic type cannot be extended far enough to use the transparency copy holder with the longer lenses. Slides can be duplicated with the longer lenses but must then be mounted on a separate frame.

In the automatic type, lenses from 80 to 135 mm focal length can be used for life-size reproduction because the lens-to-slide distance can be extended with the repro tube. The repro tube goes between lens and shade. When only a portion of the original is enlarged, in other words when magnification is more than 1:1, the 80 mm lens may again be necessary.

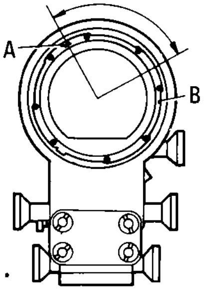
LENSES AND EXTENSIONS FOR SLIDE COPYING

Lens	Format	Bellows extension	
Planar C/80 and Planar F/80	6×6→6×6 4×4→4×4	80 mm	
	4×4→6×6	108 mm	
Planar C/100	6×6→6×6 4×4→4×4	100 mm	
	6×6→4×4	75 mm	Use the repro tube
	4×4→6×6	135 mm	
S-Planar C/120	6×6→6×6 4×4→4×4	120 mm	Use the repro tube
	6×6→4×4	90 mm	Use the repro tube
	4×4→6×6	162 mm	
S-Planar C/135	6×6→6×6 4×4→4×4	201 mm	Use the repro tube and support rod 296
	6×6→4×4	166 mm	Use repro tube and support rod 296
	4×4→6×6	193 mm	Use repro tube 55 on the bellows extension, repro tube and support rod 296

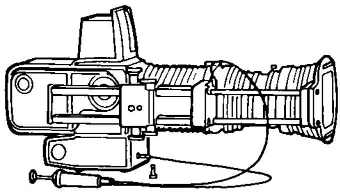
Holding the transparencies

To maintain sharpness over the entire area, the slide must lay absolutely flat in the slide holder. The original must be free of dust, dirt, fingermarks, etc. To maintain contrast, the slide must be masked so there is no extraneous light reaching the lens.

$2\frac{1}{4}$ in square transparencies in cardboard mounts, or unmounted in strips, can be inserted directly into the transparency copy holder. Individual unmounted $2\frac{1}{4}$ in square transparencies are best attached with adhesive tape to a

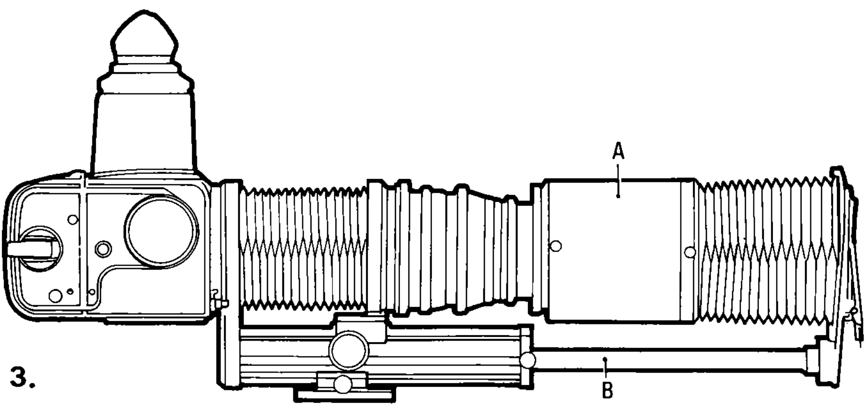


1.



2.

1 To attach the non-automatic bellows extension to the 500EL/M, remove the eight screws in the bayonet ring (B) and rotate the ring one quarter of a turn to the right so that the red index (A) is on the upper right. Re-attach the bayonet ring with the eight screws. In this position the rails will be on the right of the camera (**2**) where they do not interfere with camera operation. If the rails are placed on the other side, they interfere with the operation of the darkslide.



3.

3 The transparency copy holder of the automatic bellows extension slides into the grooved rails in the front of the shade. The transparencies are placed in the holder after lifting the diffusion glass. When a longer lens-to-slide distance is necessary, for example when a 135 mm lens is used, the repro tube (A) is mounted between the lens and the shade and the shade is mounted on the long support rod (B).

piece of thin cardboard about 3 × 5 in with a 55 × 55 mm cutout. The cardboard with slide attached is then inserted into the transparency copy holder. Glass-mounted $2\frac{1}{4}$ in square transparencies can be copied in the glass provided the glasses are absolutely clean and newly mounted. (Dust particles are also copied.) The glasses of slides that have been mounted some time are usually fogged up, reducing the brilliance, and should be removed.

Cardboard-mounted 35 mm or Superslides are mounted with adhesive tape on a piece of thin cardboard about 3 × 5 in with a cutout about 40 × 40 mm for Superslides, 24 × 36 mm for 35 mm. The cardboard with slide is then inserted into the transparency copy holder. Glass-mounted 35 mm or Superslides are best removed from the glass, and placed in the copy holder on a 3 × 5 in cardboard frame.

Light sources

Sunlight, electronic flash, and tungsten lights are three recommended light sources. With sunlight, aim the slide copying set-up with the diffusion glass directly toward the sun. As daylight film is balanced for sunlight, the colours should be correct provided you avoid the early morning or late afternoon hours. Daylight on an overcast day cannot be recommended as its colour is completely unpredictable.

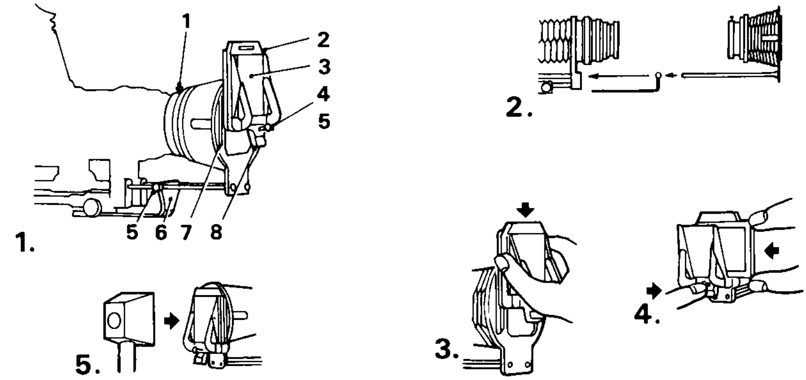
Place tungsten lamps of 3200 K (31 DM) or 3400 K (29 DM) or electronic flash units straight in front of the transparency holder shining directly on the diffusion glass. The power of the light source and its distance from the slide determines exposure. A flash unit can be placed at any distance as it produces no heat, but I would suggest leaving at least about 25 cm (10 in) between slide and light to assure even illumination. With flash you need another light source illuminating the slide for framing and focusing. Tungsten lamps, whether used for photography or for framing and focusing only, are best kept at a distance of 60 cm (2 ft) or more because of the heat.

Films

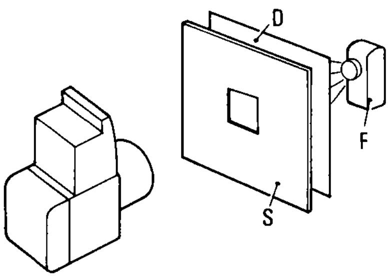
Daylight colour film is used with sunlight and with electronic flash, tungsten film for tungsten lights. Make certain that the colour temperature of the light and film match. Slide duplicating films are best for this purpose as their low contrast produces a result very close to the original. These films are, however, available only in 70 mm, and not easy to find.

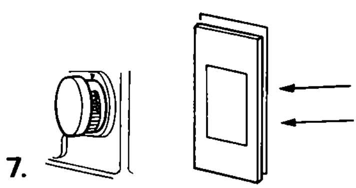
Unless you intend to produce a very large quantity of duplicates, you will have to use the regular colour slide films. I have found them to produce completely satisfactory copies with little increase in contrast if the original is of good quality. The best originals are those with a relatively low contrast. If you have a choice of colour film, use the one with the lowest contrast.

To avoid an increase in contrast on black-and-white negatives, increase the exposure slightly and reduce the developing time.



1 The transparency copy holder: 1. locking screw for lens and shade connection; 2. transparency copy holder; 3. diffusion screen of copy holder; 4. locking screw for copy holder; 5. locking screw for stabilizing bracket; 6. stabilizing bracket; 7. guide rails for copy holder; 8. lever to open slide holder.
2 The stabilizing bracket should be used in combination with the transparency copy holder. Mount this stabilizing bracket on the rails of the bellows shade. The other end of the bracket goes between the tripod mount and the tripod or stand.
3 Slide the copy holder into the rails on the front of the shade. **4** Open the holder and insert the transparency.
5 For copying, the lightsource, flash or Tungsten light is positioned in front of the diffusion screen so that it shines straight towards the camera.





In a simple slide duplicating set-up (left), the mounted camera photographs the slide mounted on a frame in a similar way to that for photographing any other close-up subject. A diffusion material (D) is placed between the light source (F) and the slide (S).

Correct exposure can be determined by holding a reflected-light meter at the camera side of the slide so that it measures the light passing through the slide. (This of course is possible only with Tungsten lights.)

Filters

The use of filters when copying slides follows the same rules and suggestions as for original photography. What you photograph is simply an image of the actual subject, rather than the subject itself. If you normally use a slightly warming filter like CR 1.5 with your electronic flash unit, use the same filter for slide duplicating. You might also find after the first test that you prefer an even warmer rendition, so try the CR 3.

Exposure

Photographing a slide is like photographing the actual subject. Hold a light meter behind the slide so that it measures the picture area as the camera sees it which is similar to pointing the meter at the actual scene.

The Hasselblad meter prism is ideal for this; not only does it measure the correct area, but it also compensates for the necessary increase in exposure due to the bellows extension, or filters if they are used. The reading on the meter, therefore, should be correct, and while test exposures should not be necessary, they are nevertheless recommended when copying for the first time. If you have a Polaroid back, use it. You can also use separate reflected light meters such as the Hasselblad meter knob.

The sunshade of the Hasselblad bellows extension does not allow a light meter to be held behind the slide, so detach the bellows sunshade from the lens or repro tube and hold the meter behind the shade pointing towards the original slide with the shade squeezed together to bring the meter as close to the slide as possible. If the meter is still not close enough to the transparency, slide the transparency copy holder with the slide out of the railings and take a reading with the meter held right behind the slide. Exposure must be increased due to bellows extension which amounts to two EV or *f* stops for life-size magnification. Set the lens to around *f* 11 for best results. If you need a long shutter speed, pre-release the camera to avoid any possible shake.

Double and multiple exposures

The copying procedure allows two or more slides to be combined into one image. Simply place the two slides together into the transparency copy holder. If both slides are to be sharp, place them emulsion toward emulsion. If one image is to be unsharp, separate the two original slides with a piece of glass and focus on the one that is to be sharp. Results can be seen and studied on the ground glass at the shooting aperture.

Contrast control

There is an increase in contrast whenever an original slide is copied. There are two ways you can reduce this. The first is masking, used frequently in laboratories. A special type of black-and-white film called masking film is exposed

in contact with the original slide. After developing, the mask looks like a thin negative with some density in the light areas of the original and little or none in the dark areas. Colour filters can be used when the mask is made to lighten or darken certain areas. The mask is placed in register with the original while the duplicate is made and compresses the contrast range. Masking is an effective, but a slow and time consuming process.

The second method of increasing contrast, called flashing, is generally more appealing. Flashing means making a second brief exposure on the film with the original slide removed. This second exposure shows up in the dark shadow areas and prevents them from going black. As a result, the contrast is reduced. The amount of flashing is very critical. If it is too short, there is no visible effect or improvement; if it is too long there will be an overall fogging effect. The optimum flashing is usually about 10% of the full exposure time, but tests must be made. It is practical only with electronic flash. The correct flashing exposure is obtained by placing a heavy neutral density filter over the flash unit or behind the slide. For a 10% light transmission, the filter needs a density of 1.0 (use a 0.9).

Copying slides without special equipment

As copying slides means nothing more than taking a picture of a slide, the special camera set-up with bellows extension and transparency copy holder is not really necessary. You can photograph the slide as you would a close-up picture of a small subject, but mount the transparency on a card with a suitable cut out or arrange for it to be evenly lit.

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Macro and Micro Photography

Close-ups with Luminar lenses

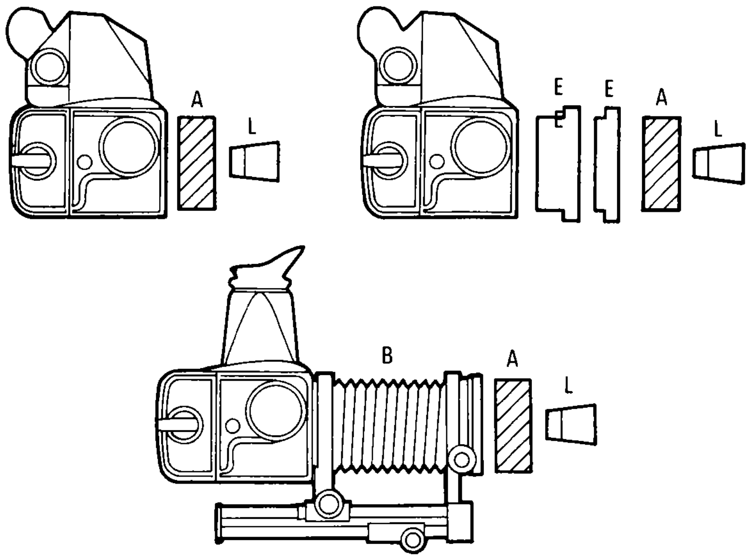
With the Hasselblad close-up accessories and lenses, magnifications up to approximately $3\times$ can be obtained. For higher magnifications, there are special objectives made for this purpose, which provide an easy solution.

Zeiss Luminar lenses are photomacrographic objectives designed for high magnification photography. They can be used on a camera in a very similar fashion to regular camera lenses. On Hasselblad, they can produce pictures with magnifications up to about $20\times$, i.e. the entire $2\frac{1}{4}$ in square format is filled with a subject less than 3 mm ($\frac{1}{8}$ in) in size. These lenses fill the $2\frac{1}{4}$ in square format with superb corner-to-corner quality as they are designed to cover the 4×5 in format.

Luminar lenses are available in five focal lengths: 16 mm, *f*2.5; 25 mm, *f*3.5; 40 mm, *f*4.5; 63 mm, *f*4.5; and, 100 mm, *f*6.3. Being photomicrographic items, they are sold through microscope dealers, not camera stores.

Mounting Luminars on the Hasselblad

The 16 mm, 25 mm, 40 mm, and 63 mm lenses have what is known as the RMS thread, which is the standard thread found on microscope objectives. The lenses can therefore be screwed directly into the Hasselblad lens mount adapter, whilst the lens mount adapter is attached to either the camera, the Hasselblad extension tubes or the Hasselblad bellows extensions. Since the Luminar lenses have no focusing ring, the bellows extension is the most practical accessory. When bellows are used, focusing and changing the magnification is done by extending or shortening the bellows. When the lens is mounted directly on the camera or on the extension tubes, focusing is done by moving the entire camera rig until the image is sharp.



The luminar lenses are specially designed for macrophotography and give their best image definition at scales of reproduction in the extreme close-up and macro range. The luminar lenses (L) do not have a shutter but are fitted into the camera via a lens mount adaptor (A). The lenses can be used with extension tubes (E) or bellows (B) but in both cases the lens mount adaptor is used. One or several extension tubes can also be added to the bellows extension. The most practical arrangement is with the bellows which permits focusing and changing the lens-to-subject distance.

The microshutter can be added in all cases. The shutter always goes next to the lens.

Shutter control

Luminar lenses have no shutter. The 2000FC with its focal-plane shutter is therefore the most logical camera to consider. However, since most of the Luminar work is done indoors, the 500C/M and 500EL/M are probably just as good. To make the exposure with the 2000FC, the shutter speed is set and the camera release is depressed as with regular lenses. Pre-releasing is recommended. Flash exposures are made in the same way up to 1/90 sec with the sync cable connected to the 2000FC body.

Photography with Luminar lenses requires a lot of light, so existing-light photography is impossible. Tungsten lights are impractical due to the heat they produce. Electronic flash is by far the most satisfactory light source: bright, short, cool. Most of my work is done with a studio unit around 400 watt-seconds. With electronic flash, a camera or lens shutter is not really necessary. On the 500C/M, depress the pre-release, fire the flash, push the release and advance the film. On the 500EL, push the time and charging lever to T, fire the flash and push the lever back to O. In this open flash method, the double cable release of the non-automatic bellows extension need not be used.

On the 500C/M and 500EL/M, the shutter speed can be controlled from

1 sec to 1/500 sec plus B with the microshutter. This accessory, which from the outside looks like an 80 mm lens, is nothing but a Compur shutter. There is no glass in the mount. The lens mount adapter with the Luminar lens is attached to the microshutter, and the combination placed in front of the bellows extension, the extension tubes, or the camera if no close-up accessory is added. The lens mount adapter with the Luminar lens always goes in front of the microshutter so that the lens is closest to the shutter. The microshutter also provides flash synchronization up to 1/500 sec. The bellows extension operation with the microshutter is the same as with shutter lenses.

Exposure

Zeiss Luminar lenses have a built-in diaphragm which is used, as on any other lens, for allowing more or less light to the film and changing the depth of field. Their engravings (1, 2, 4, 8, 15, 30 and 60) are not aperture ratios as we know them from our regular photographic lenses but exposure factors. The relationship from one number to the next is the same as with *f* stops: the next lower number lets in twice as much light.

Once the correct exposure has been established for one diaphragm setting, it is easy to determine the exposure for any other setting.

For example, if the correct exposure for setting 2 is 1/8 sec, the correct exposure at setting 8 is $\frac{1}{2}$ sec, i.e. the multiplying factor ($8 \div 2 = 4$) times $\frac{1}{8}$ sec.

Tests made with the 25 and 63 mm Luminar lenses have shown that the engraved exposure factors are approximately equivalent to the *f* apertures, thus:

f apertures	1	2	4	8	15	30	60
63 mm lens	4.5	6.3	9	12.5	18	25	36
25 mm lens	3.5	4.5	6.3	9	12.5		

A reading with a regular exposure meter for daylight or tungsten (or a flash meter, when electronic flash is used) can therefore give at least a starting point for correct exposure. You must, of course, consider the magnification, and adjust the exposure in the usual way.

Choice of lenses

The chart, Luminar lenses on Hasselblad, shows the magnification with the various lenses and camera accessories, as well as the working distances (distance from lens to subject).

It is possible to obtain a certain magnification with different Luminar lenses; for instance, a 5× magnification can be obtained with all the lenses from 16 mm to 63 mm, the difference being only in the working distance,

which varies from about $2\frac{3}{4}$ in with the 63 mm to $\frac{3}{4}$ in with the 16 mm lens. This working distance is one of the elements determining the choice of focal length; the other is the optical performance of the lens.

Luminar lenses, being designed for a specific purpose, can provide maximum optical performance only within specified ranges of magnification indicated below. It is highly recommended to use the lenses only within the listed range of magnification, especially when photographing at large apertures.

MAGNIFICATION RANGES FOR LUMINAR LENSES

Luminar lens	*Maximum performance*	*Good performance between*
63 mm	3.2 ×	2 × to 10 ×
40 mm	5 ×	3 × to 16 ×
25 mm	10 ×	5 × to 25 ×
16 mm	16 ×	9 × to 40 ×

LUMINAR LENSES ON HASSELBLAD

	63 mm		40 mm		25 mm		16 mm	
Camera accessory	M	D	M	D	M	D	M	D
40037 only	0.4	6	1.4	$2\frac{1}{2}$	2.8	$1\frac{1}{4}$	5	$\frac{3}{4}$
40037 + 40169	1.6	5	3	2	5	$1\frac{1}{2}$	9	1
40037 + 40223								
At Min. Ext.	1.6	5	3	2	5	$1\frac{1}{2}$	9	1
At Max. Ext.	3.7	$2\frac{3}{4}$	6.3	$1\frac{1}{2}$	11	$\frac{3}{4}$	18	$\frac{1}{2}$
40037 + 40169 + 40223								
At Min. Ext.	2.5	$4\frac{1}{2}$	4.5	2	7.5	1	12	$\frac{3}{4}$
At Max. Ext.	5	$2\frac{3}{4}$	8	$1\frac{1}{2}$	13	1	22	1

NOTES: 40037 Lens mount adapter
40169 Microscope shutter
40223 Bellows extension
M = Magnification
D = Approx. working distance in inches (distance between Luminar lens and subject).

PHOTOGRAPHY THROUGH THE MICROSCOPE

Photography with Luminar lenses, which covers a magnification range up to about 20 ×, is known as photomacrography. Higher magnification can be obtained with a compound microscope which consists of an objective lens and an eyepiece lens. The eyepiece magnifies the image created by the objective.

Photography through the microscope is referred to as photomicrography. It should not be confused with microphotography which is just the opposite—

the technique of making a very small precision photograph of a large object rather than producing a greatly enlarged image of a very small object.

The microscope has long been one of the most important research instruments in the medical, industrial and educational fields. It is also a fascinating tool for the amateur photographer giving him the opportunity to see and record on film unusual and beautiful arrangements of lines, patterns and colours which cannot be seen by the naked eye. The image photographed through the microscope can be viewed as a slide or as a print by any number of people.

Cameras

All Hasselblad SLR models can be used to record the image produced by the microscope, either as a full $2\frac{1}{4}$ in square or in Superslides. The Polaroid film magazine can be a most valuable accessory for checking exposure, lighting, contrast and the reproduction of the various colours. Special photomicrographic emulsions if necessary can be used in the cut film holder.

The special features in some of the Hasselblad models offer advantages. The EL/M, for instance, reduces the possibility of moving the camera and disturbing the delicate microscope set-up while advancing the film. It allows rapid exposure sequences—12 images within about 10 secs. The change in a specimen can be recorded automatically at regular intervals by connecting the EL/M to an intervalometer.

The 2000FC is an excellent camera for photomicrography because the shutter is in the camera body, and this work is done without a lens on the camera. The microscope shutter can then be substituted for shutter control and flash synchronization up to 1/500 sec. This additional accessory is not necessary on the 2000FC, unless flash synchronization is necessary at shutter speeds shorter than 1/90 sec.

Photomicrographic set-up

The Hasselblad camera without lens, but with microscope shutter if necessary, is mounted on a separate camera stand centred above the microscope eyepiece. A sturdy stand with heavy base, made specifically for this purpose, is highly recommended for serious and professional work. The connection to the microscope eyepiece is made with the microscope adapter, which attaches either to the camera body, the microscope shutter or bellows extension. It is not really a connection. The microscope adapter is just a short flexible bellows that holds a microscope eyepiece with a standard 23.2 mm diameter. Its purpose is to prevent stray light entering between microscope and camera. Its flexibility eliminates transferred motion between the camera and microscope.

When the microscope adapter is used alone, the image fills the entire

$2\frac{1}{4}$ in area. Combined with microscope shutter, the image is circular, filling the Superslide format but not the entire $2\frac{1}{4}$ in square. To fill the square, the film plane must be moved further back, which can be done with the bellows extensions. The microshutter must be next to the microscope eyepiece, so that it is in front of the bellows extension. The bellows extension can also be used without the microshutter, when its purpose is simply to move the film plane further from the eyepiece thereby increasing the magnification.

Magnification

The microscope magnification (M) for visual observation is obtained by multiplying the objective magnification (Mo) and eyepiece magnification (Me), i.e. $M = Mo \times Me$. This relationship is maintained in photography only if the film plane is 25 cm (10 in) above the exit pupil of the eyepiece. Magnification can be changed somewhat by shortening or lengthening the eyepiece-to-film plane distance (D) according to the formula:

$$M = Mo \times Me \times \frac{D}{250}, \text{ where D is in millimetres.}$$

Framing and focusing

The focusing screen of all Hasselblad cameras shows the area of coverage in photomicrography as it does in all other photography. The image can also be focused on the ground glass, but here focusing becomes increasingly difficult as the magnification increases, because the ground glass grain makes it difficult to see the fine details of a microscopic specimen. A clear glass with cross hair is sometimes used for this purpose. Such a screen is available for Hasselblad models with an interchangeable ground-glass screen. It works well in photomicrography but is not suited to most other applications.

If you find ground-glass focusing completely impossible, try the split image rangefinder screen with the clear centre, or, better still, focus with a separate focusing eyepiece on the microscope. Special microscope attachments with their own viewing and focusing eyepiece are made for most microscopes. Some of them offer the additional benefit of a built-in light measuring cell for exposure determination.

Exposure determination

If a special accessory with metering device is not used, the necessary exposure time is best determined by a film test. With the modern sensitive Silicon and and CdS exposure meters, exposure can be determined in various ways. An attachment, usually a fibre optic, can be used to measure the light on the

ground-glass screen. Some meters have an attachment to measure the light in the ocular tube of the microscope. The same accessory can also be used for meter readings through a telescope. Just holding one of these very sensitive meters above the ground glass might possibly give a reading. At low magnifications with bright light sources, the sensitivity of the Hasselblad meter prism may also be sufficient for a meter reading. Keep in mind, however, that you are not working with a lens with EV and aperture control. The reading obtained on one of these meters is only useful as a guide for future work.

The shutter speed must still be determined from a film test. But once you know what meter reading produces the correct exposure, you can use this as a guide to adjust the light in future work to the same level or use it as a guide to how the shutter speeds must be adjusted when light levels are lower or higher, or when different films are used.

Exposure can be changed only at the light source by using neutral density filters, or changing the shutter speed. When exposure times exceed 1 sec, reciprocity law failure must be considered.

The quality of photographs is determined almost completely by the microscope, its objectives and eyepieces. The camera is involved only to the point of holding the film flat in the magazine. Certainly, only the best corrected microscope lenses and achromatically corrected condensers are satisfactory for colour photography. However, it is not just a question of buying high quality lenses, but knowing which objective and which condenser system produce the best results in a given situation. The microscope should have an interchangeable condenser system for low and high magnification.

The aperture used for illumination (condenser aperture) must be as close as possible to the aperture used for taking the pictures (numerical aperture of objective) so that the colours retain their natural luminosity.

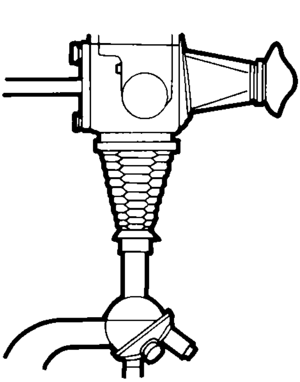
The selection of the eyepiece must be based on the objective used. A photo eyepiece is better corrected for curvature of field and therefore produces a moderately flat field. In photography with the Hasselblad where a camera lens is not used, it is recommended that the microscope be equipped with an adjustable eyepiece which permits focusing for the eyepiece to film plane distance.

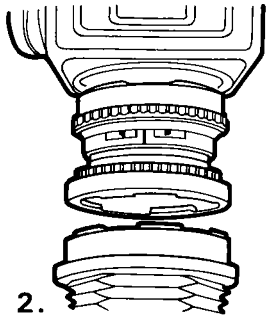
The specimen and the cover glass must be considered part of the optical system. Proper thickness of the cover glass is very important. For best quality with the minimum of spherical aberration, they should be between 0.16 and 0.19 mm thick. Cover glasses that are too thick or too thin will introduce spherical aberrations, a cause of poor photomicrographs.

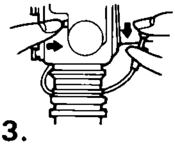
Light sources

The most common light sources used in photomicrography are:

1. *Carbon arc lamps.* They are extremely bright, therefore used mostly in motion picture work. Colour temperature 3600 K to 3800 K. Usable with



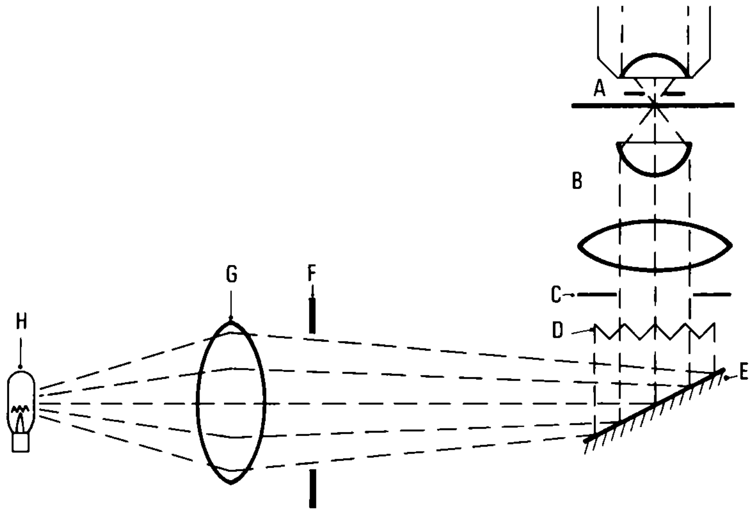




1 In photomicrography the eyepiece forms the image on the film so no camera lens is used. The microscope adapter holds the eyepiece and shields the camera from extraneous light. The eyepiece is dropped into the microscope adapter and the adapter is then attached to the camera like a lens.

2 If shutter control is necessary on the 500C/M and 500EL/M the microshutter is placed between camera and microscope adapter. The microshutter is set and used exactly as a shutter lens (it is effectively a Compur lens mount without glass). If the image does not fill the entire $2\frac{1}{4}$ area, the eyepiece-to-film distance can be lengthened with the bellows extension placed between microshutter and camera.

3 Pre-releasing is highly recommended as well as the use of a cable release when exposure times are long.



4 The recommended specimen illumination is obtained by first centring the lamp and then changing the distance between lamp (H) and the condensor lens on the lamp until a sharp image of the filament is recorded on the back surface of the stopped down substage diaphragm (C).

Stop down the field diaphragm (A). Adjust the position of the substage condensor (B) until you see a sharp image of the field diaphragm on the ground-glass of the camera. The image of the field diaphragm is then recorded in the specimen plane. Open the field diaphragm just enough so its image fills the entire diameter of the objective lens.

daylight and with tungsten films with the necessary colour-balance filters.

2. *Incandescent tungsten lamps.* Most common, and frequently built into the microscope. Usually 2700 K to 3200 K depending on voltage and current used. Commonly used with tungsten films with the necessary colour-balance filters.

3. *Mercury vapour lamp.* For black-and-white photography only. Excellent for ultraviolet and fluorescent work.

4. *Xenon arc lamp.* Extremely bright. Light is of daylight quality and can therefore be used with daylight colour films without or with little filtering. It has great brightness in the infra-red range and is therefore ideal in combination with infra-red film.

5. *Zirconium arc.* Very bright, brighter than common low-voltage tungsten lamps. Colour temperature of light is 3200 K, therefore ideal for use with type B colour films.

6. *Electronic flash.* Ideal for moving specimens because of short flash duration. An auxiliary tungsten light is necessary for alignment, focusing and viewing the specimen.

Lighting arrangement

The success of a photomicrograph depends almost completely on the illumination of the specimen which is adjusted with the lamp, the condenser lenses and the aperture and field diaphragms. These diaphragms are built into microscopes not for adjusting light levels but for the purpose of creating best image contrast.

The procedure and the adjustment of all components is based on the Koehler lighting principle which provides virtually glare-free and even illumination over the entire field. The principle consists of projecting the filament of the lamp on to the lower focal plane of the condenser.

For maximum illumination the image should just fill the bottom lens of the condenser. When this is accomplished, the field diaphragm is stopped down and, while viewing through the microscope, the substage condenser is moved until a sharp image of the diaphragm is observed in the object plane (the microscope should be focused on the specimen). The field diaphragm should also be centred, if necessary. The field diaphragm is then opened just slightly larger than the entire microscope field seen in the eyepiece or on the camera ground glass. This eliminates glare, as only the light beam participating in the image formation is permitted to reach the object plane.

The adjustments made for one objective may have to be changed when another one is used. Just as in visual observation, various investigation methods, such as transmitted or incident light, bright field or dark field, phase contrast, fluorescence and polarization, can be used for photographic purposes.

19

Copying

PHOTOGRAPHS OF DOCUMENTS must have edge-to-edge sharpness, good contrast, even exposure over the entire image area and true colours, if done in colour.

Camera alignment

The basic rule in copying is to square up the camera with the original. This means that the plane of the original and the film plane must be exactly parallel. The lens axis is then at right angles to both. Any deviation leads to a dimensional distortion of the image. While this is disturbing even in simple copying work, it is totally unacceptable for precision copying, in photo-mechanical reproduction, when making printing plates, and especially in the production of masters for printed circuits, etc.

The frequently used hit-or-miss method of visually examining whether the camera seems to point straight at the copy can never be sufficiently accurate and better methods must be found. Here are some useful ideas to consider. A spirit level on the camera assures rather accurate horizontal positioning of the camera. Such a spirit level is built into the Hasselblad Superwide camera, and is available as an accessory for the other models. A camera aligned with a spirit level will have the film plane reasonably accurately parallel to an original mounted on a wall, at least in one direction. If the object to be photographed has definite parallel lines, for instance a picture frame, align the camera as carefully as possible so that the two horizontal lines of the frame are perfectly parallel to the horizontal edges of the viewing screen and the two vertical lines parallel to the vertical edges. The ground-glass screens with engraved vertical and horizontal lines (checked screen) simplify this alignment as the vertical and horizontal lines can be checked along each engraved line.

A simple, accurate, yet seemingly unknown method involves a mirror which is placed on the copy while watching the reflected image. It is used as follows: Obtain a small frameless mirror about 5–10 cm (2–4 in) in size. Place

the mirror, as accurately as possible, in the centre of the subject. Set the camera the correct distance from the subject, and adjust the focus to produce a sharp reflection of the camera. Move camera in any direction until the mirror is centred on the ground-glass screen and the camera lens reflected in the centre of the mirror. The camera is now reasonably well centred above the copy with the film plane parallel to the copy.

With Hasselblad, the simplest, quickest, and by far the most accurate alignment of the camera is achieved with the linear mirror unit. This accessory is specifically made for the purpose and uses the principle of reflection between two mirrors. A large flat mirror is placed over the copy and a small circular mirror goes on the camera. The accuracy and use of the mirror are described in detail at the end of the chapter.

Focusing

When camera and copy are aligned parallel to each other, focus the lens as accurately as possible. If the subject does not have fine details for precise focusing, place a substitute focusing target over the copy, e.g. a piece of paper with very fine detail (fine newsprint).

Films

The quality of the reproduction often depends on the brilliance of the copy. Brilliance is the result of contrast, resolving power and graininess. As graininess and resolving power are usually directly related, fine grain emulsions are highly recommended. Grain is more objectionable in copying than photographing other subjects. Usually films of lower sensitivity are preferable as they have better definition and less grain.

If maximum contrast is desired, developing times should be increased by about 20%. For continuous-tone originals, regular black-and-white films of moderate contrast are best. They can also be used for line originals but high contrast films are better for this purpose. Special high-contrast emulsions are available in 70 mm and in sheet film.

For colour images, the same colour films are used as for all other colour photography, daylight type for electronic flash, tungsten type for quartz lights.

Lenses

Maximum brilliance requires a clean camera lens of high resolving power, accurate focusing, a steady camera, and proper exposure and development. All Hasselblad lenses are suitable and good enough for copy work. For the corner-to-corner sharpness required in copy work, I suggest closing down two or three stops. There are two lenses in the Hasselblad line specifically designed for copying, the S-Planar 120 mm and 135 mm *f*/5.6 are designed to

perform at their best in the reproduction scales from 0.1 to 0.5, not at long distances. The S-Planar lenses have high modulation transfer values which result in the high-contrast images necessary in reproduction work. Optimum correction is at *f* 11.

For copying large documents, the Superwide should be considered seriously. The Biogon lens provides a distortion-free negative or transparency with super corner-to-corner sharpness even down to the 30 cm (12 in) minimum distance. At 39 cm it covers an area 22 cm (11 in) wide. Its value is especially appreciated when it is necessary or desirable to photograph large originals from a short distance. The distance setting of the lens in close-up shots is determined by measuring the subject-to-film plane distance or by visually focusing on the ground-glass screen adapter.

Filters

When photographing in colour, filters are necessary only for special effects or when the colour temperature of the light source does not match that of the film. When photographing coloured originals on black-and-white film, on the other hand, colour filters are used to increase or reduce the contrast, or to suppress or emphasize certain sections of the original (see chapter 14, Filters). A yellow filter can be of value when photographing old, yellowed originals as it will lighten the yellow background and thereby increase the contrast.

Lighting

In an emergency copying can be done in daylight. If so, the soft light of an overcast day is better than sunlight which washes out dark areas. When working in colour on an overcast day measure the colour of the light with a colour temperature meter and use the necessary correction filters.

For serious copying it is better to work under controllable artificial lighting, where you can select the type, the colour, the position and the amount of light. Tungsten lights are best. You can use electronic flash but this is less satisfactory because you cannot see the results.

Lighting must be even from corner to corner and without disturbing reflection. For smaller documents you can use two identical lights. Place them at equal distance on two sides far enough away to cover the entire area and each at an angle of approximately 35°. For larger objects use four identical lights, two on each side. The best way to achieve even illumination is by tilting and moving each light separately until it lights the proper area while the other or others are turned off. The most even lighting is obtained when each light is aimed at the far side of the copy. Check the evenness of the lighting with an exposure meter. This flat, shadowless lighting is used in most cases as it suppresses surface detail and patterns.

When surface detail is to be shown, as for instance when photographing

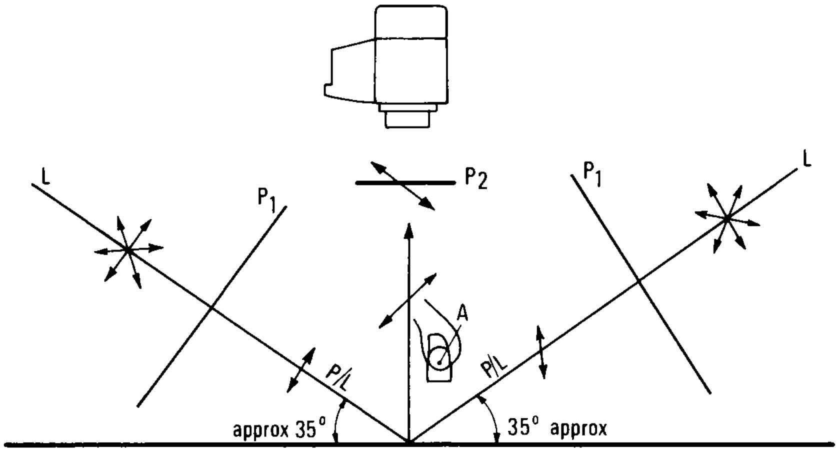
oil paintings where brush strokes are an integral part, a side light is necessary. One or two lights on the same side should be placed so low that the light beam just touches the surface, highlighting one side of the brush strokes while the other is in shade. If necessary, a weak fill-in light can be placed on the other side to add some overall illumination without destroying the highlights and shadows.

When you work in colour, be aware that surrounding areas, walls, ceilings, floors may reflect light onto the original and change its colour, particularly if the walls and ceilings are coloured or have wood panels. Select a room with white or grey walls and ceilings, or shade the lights with barn doors or in some other way so their light falls only on the copy, not on walls and ceilings.

Polarized light

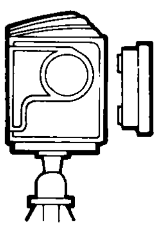
Copying results can be improved, often dramatically, with polarized light which eliminates or reduces reflection and produces images with higher contrast. Polarized light is recommended for photographing coloured copy, shiny surfaces such as glossy photographs or pictures under glass, and charts on black backgrounds. Polarization makes the background really black instead of grey and, even more valuable, faint pencil lines and other marks need not be erased as they disappear completely.

These improvements can be accomplished only if the light that reaches the copy is polarized and the polarizing filter on the camera lens is rotated for cross polarization. Filters that are placed over tungsten light sources must be heat resistant, and such filters are expensive. A less expensive solution is to use sheets of polarizing material which are placed away from the lights. This is perfectly satisfactory as long as the filter sheet is large enough to encompass all the light reaching the object. My own set-up consists of 14×17 in sheets mounted in picture frames and placed on each side of the copy stand. If several lights are used, the polarizing filter between each light and the object must be polarized in the same direction. The filters are usually marked but, if not, hold two on top of each other, and look through them while turning one; they are polarized in the same direction when most light goes through. The polarizing filters on the light sources and the one on the lens must be accurately adjusted with respect to each other for best results. Proceed as follows: First turn on one light with the polarizing filter in place. Put a shiny coin in the centre of the copy and, while viewing through the camera, *turn* the polarizing filter *on lens* until the coin shows minimum reflections. Turn off the first light and turn on the second. Turn the polarizing material *in front of light* until the coin shows minimum reflections (without touching filter on lens). Proceed the same way with the other lights if more than two are used. The 35° angle recommended for the light source is most efficient for polarization.



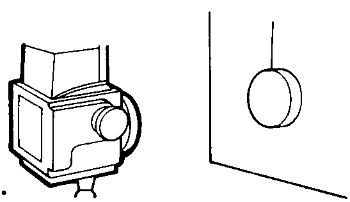
1.

1 A simple set up for copying in polarized light consists of a sturdy tripod with the center post reversed so that the camera is held between the legs. Two lights (L), one on the left the other on the right, illuminate the copy from the same angle. The light from both lamps goes through the polarizing material (P_1), which can be mounted in picture frames, so that the light falling on the copy is polarized. A polarizing filter (P_2) on the camera lens is turned to produce maximum contrast. Exposure is based on a meter reading (A) off a grey card placed on top of the copy.



2.

3.



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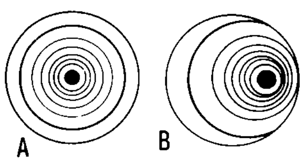


5.

To use the linear mirror unit, place the lens flange mirror into the camera's lens mount (**1**) and the large mirror over the copy (**2**), vertically or horizontally. Remove the film magazine and look through the open back (**3**). Successive circular images can then be seen (**5**). Move and turn the camera until the circles are concentric as shown in **5**A. The camera is out of alignment if the circles appear as in **5**B.

Exposure

With any type of copy, accurate exposure determination is obtained either by placing an incident meter in the centre of the copy and measuring the light falling on the copy, or, if flash is used, by holding the flash meter over the copy. With a reflected hand-held or built-in meter, place a grey card over the copy and measure the light reflected off the card. Make certain the meter measures only the grey card and none of the surrounding area, especially not when it is black or white. Alternatively, take a reflected meter reading from a white card but with the meter set to 1/5 the ASA exposure index of the film.

If polarized light is used, the measurement is naturally made with the polarizing filter over the lights. In addition, it is necessary to compensate for the polarizing filter on the lens if measurement is made with a separate meter.

Copy stand

For copying large originals you might find a horizontal camera with the original mounted on a wall best. For originals up to about 30 or 40 cm (12 × 16 in), vertical copying is usually easier. If done extensively, a special stand is recommended; it offers some conveniences, such as a firm support for the camera, a simple way of changing the distance between copy and camera, and frequently also has built in lights. A sturdy tripod makes a good support for horizontal work, and can also be used for vertical set-ups if the tripod head tilts 90°.

An even sturdier tripod set-up results when the centre column can be reversed so the camera sits between the tripod legs. The whole purpose of the set-up is to eliminate the possibility of camera motion—a good case for pre-releasing the camera.

Final preparation

To assure the best possible quality, it is best to turn off all room lights and close curtains or shades to keep out daylight. There should be no strong light in the room other than the lights used for the photography.

Check carefully that nothing from the room, the camera, the copy stand or the photographer is reflected on the copy. This is especially important when glossy surfaces are photographed, e.g. pictures under glass and glossy photographs. Reflections must also be checked with flat copy as bright highlights, especially from the chrome parts of the camera, can be reflected. If this is the case, shade the reflecting part from the lights. Shading chrome cameras or lenses from the light is a good safeguard in any case. When checking for reflections, place your hand, arms, eyes in exactly the place they will be, as a white shirt, arms, sleeves or jewellery can also reflect light on the copy.

The linear mirror unit

The complete Hasselblad linear mirror unit consists of two optically plane mirrors in special mounts. The large circular mirror is set in a heavy mount and is placed against the original. It can be hung on a wall for vertical copying. Vertically or horizontally, the mirror is perfectly parallel to the original. The second smaller mirror, called the lens flange mirror, is set in a bayonet mount to fit the front of the camera in place of a lens.

Mounted on the camera, the lens flange mirror is perfectly parallel to the film plane. It has a small central viewing aperture. Surrounding this aperture, on the silvered side, and concentric with it is a circle. Place the camera at the correct distance, and remove the lens and film magazine. Check the alignment by viewing through the open back of the camera and through the central aperture in the mirror. You see a series of reflected circles produced by the circular lens flange mirror being reflected by the large mirror on the original. Successive circular images, getting progressively smaller, are formed by reflection and re-reflection of the first image. When the planes of both mirrors are absolutely parallel, all the circles are concentric within each other. The slightest departure from parallelism between the mirrors makes the circles bunch up or run out of each other.

Move, turn or tilt the camera until the circles are concentric as shown. The accuracy in the alignment depends on the separation of the two mirrors but is always extremely accurate. At distances of 1–2 m (3–6 ft), a deviation as small as one tenth of a degree in the angle between their planes becomes distinctly noticeable.

20

Older Models

Operating the 1000F and 1600F models

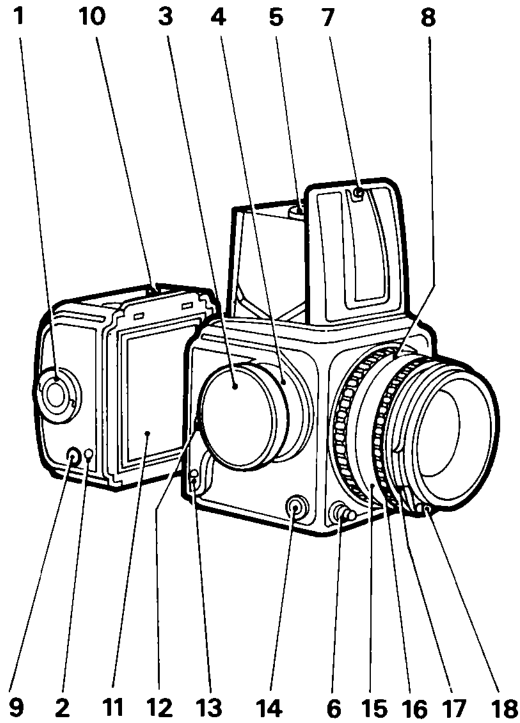
Interchangeability of components. The film magazines and viewfinders of the 1000F and 1600F models are changed in identical fashion as on the 500C/M and other newer models. We must, however, add the same warning as for the 2000FC camera. The stainless-steel shutter is only 6/10000 inch thick and can easily be damaged. Be extremely careful when the magazine is off the camera. Do not touch the shutter curtain; do not lay the camera down or store it in a case without a magazine attached; and, most of all, attach magazines very carefully so the corner does not hit the shutter curtain.

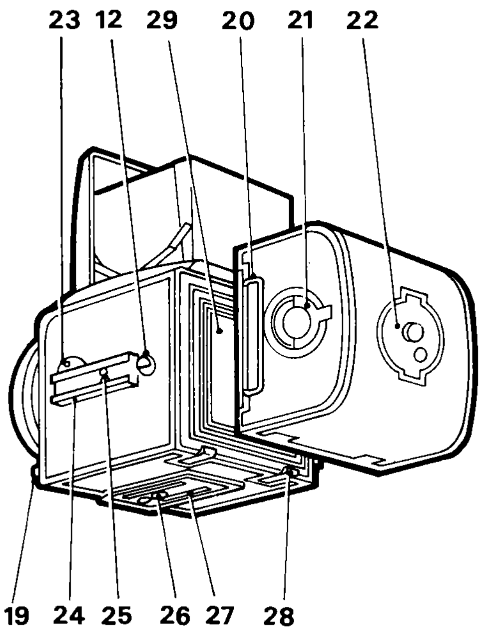
The safety interlock prevents the removal of film magazines when no dark slide is inserted. As the cameras take the same roll film magazines, film loading follows the previously described method. The very early types of film magazine did not have the end of the roll film lock which means that you can still take pictures after the film has gone through the magazine. If you have such a magazine, check the exposure counter frequently.

Your 1000F and 1600F may have one of the older viewing hoods where the magnifier is on a foldable arm rather than a panel which covers the top completely. The old magnifier and the viewing hood are opened and closed in the same fashion as the present types and you can update your 1000F or 1600F by equipping it with any one of the present viewfinders.

The 1000F and 1600F models have a bayonet lens mount, which differs from the newer models and lenses and are therefore not interchangeable. It is also not practical to adapt newer lenses to the older cameras or vice versa. The lens release button is in the same place, on the lower left. To remove a lens, press the button, turn the lens one third of a turn counter-clockwise and lift it out. To attach a lens, align the two red dots on lens and camera and turn the lens one third of a turn clockwise until it clicks in position. As there is no coupling shaft between camera and lens, lenses can be removed or attached at any time, with the film advanced or not.

The 1000F and 1600F





1. Magazine loading key.
2. Film transport signal on magazine.
3. Shutter tensioning and film transport knob.
4. Shutter speed scale.
5. Focusing magnifier of finder hood.
6. Shutter release button.
7. Release catch of finder hood.
8. Depth of field scale.
9. Film counter of magazine.
10. Magazine catch.
11. Magazine slide.
12. Lug for carrying strap.
13. Transport signal on camera.
14. Cable release socket.
15. Distance scale.
16. Focusing mount.
17. Aperture preselector ring.
18. Rapid stop-down aperture lever.
19. Lens changing catch.
20. Handle of magazine slide.
21. Film holder lock of magazine.
22. Film indicator (and window in magazine back).
23. Synchronizing lever.
24. Accessory shoe.
25. Flash contacts.
26. Tripod sockets.
27. Base plate.
28. Hooks to engage film magazine.
29. Focal-plane shutter.

Two extension tubes, 20 and 40 mm, and a bellows extension with sunshade have been available and are attached between camera and lens in the normal fashion. The bellows is used in the same way as the present non-automatic version. Since the lenses have no shutters, the shutter cocking feature is not present and a double cable release is not necessary.

The close-up data in the charts for the new cameras, lenses and accessories apply to the above extension tubes and bellows if one keeps in mind the focal length of the lens and length of extension tubes. Use the data for one 21 mm tube for the 20 mm tube, and the data for two 21 mm tubes for the 40 mm tube.

Releasing and shutter operation. The 1000F and 1600F models are equipped with stainless steel focal-plane shutters with speeds up to 1/1600 sec on the 1600F model, 1/1000 sec on the 1000F.

The shutter speed is controlled by delaying the release of the second curtain. At shutter speeds 1/25 sec or longer, the second curtain does not move until the first one has reached the other side; at faster speeds, it starts to move before 1/25 sec which is therefore the fastest shutter speed usable with electronic flash. The shutter speeds are set on the winding knob. To do this, pull out the knob and turn it clockwise until the desired shutter speed is opposite the red triangular index mark on the camera body. You can set the shutter speed before or after cocking the shutter.

The camera operation is similar to the 2000FC. When the release is depressed (with or without cable release) the mirror swings up and the focal-plane shutter makes the exposure. The release cannot be depressed a second time without turning the winding knob.

The cable release does not attach into the release button but into a separate socket on the right side of the camera, next to the release. The cable release opening can be protected from dust with a screw-in cap. Because of the safety interlock, the release can be depressed only when the dark slide is removed. On older magazines, however, the dark slide needed to be removed only about ¼ in (5 mm) (not halfway as on the newer types) to free the release, so it is a good idea to visually check and make certain that the dark slide is actually removed.

The shutter is re-cocked and the mirror lowered with the full turn on the winding knob. This, of course, also advances the film. For double exposures, the magazine is removed as described. The operating signals (red and white) were already built into the 1000F and 1600F models.

Lenses and lens operation. The standard lens was originally a Kodak Ektar *f*2.8, later on an 80 mm Tessar *f*2.8. Accessory lenses consisted of the 60 mm *f*5.6 Distagon, 135 mm Sonnar *f*5.6, and 250 mm Sonnar *f*5.6 and a considerably larger 250 mm Sonnar *f*4. The last was designed for standard series IX drop-in filters held in place by the lens shade. All other lenses take standard

series VII drop-in filters. A retaining ring holds these 50 mm filters in front of the lenses.

All lenses offer aperture pre-selection which speeds up focusing and shooting. Set the aperture that you want to use by turning the pre-selection ring until the aperture is opposite the index mark. The aperture is now pre-set. For focusing at the maximum aperture, turn the aperture ring with trigger (milled front ring on 135 mm lens) all the way to the right (when looking down). This opens the diaphragm. After focusing, turn the ring to the left as far as it goes which re-sets the diaphragm at the selected aperture. The nice part about this arrangement is that you can do it without removing your eye from the finder. You can focus wide open and set the aperture immediately afterwards while viewing through the finder. You can tell whether the lens is stopped down by checking the red index marks. The red rectangle on the thin ring should be opposite the red dot on the diaphragm scale.

Flash photography. The 1000F and 1600F cameras have an accessory rail on the side. It can be used for a sports viewfinder which looks similar to the type available for the present cameras. The accessory rail also contains the flash contacts. To connect the sync cable to the camera, you need, however, an accessory. This can be the sports finder mentioned above which also contains the flash cable connection or a flash shoe which was available with the standard 3 mm contact and a type A contact. Each flash attachment and the sportsfinder had two contacts—one marked 'flash' (for FP flashbulbs), the other 'strobe' (for electronic flash or M flash bulbs), both at shutter speeds up to 1/25 sec.

Depending on the type of flash, one other adjustment may be necessary. Above the accessory rail is a curved synchronizer disc with pin which can be set opposite numbers 1 to 5. For electronic flash, no adjustment needs to be made. It is synchronized at all speeds (on the 1000F, numbers 1 and 2 are not in use). For flash bulbs consult the following chart.

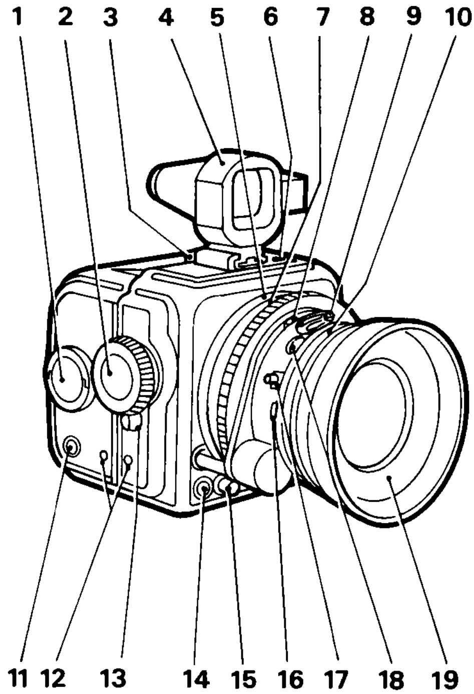
Flash bulbs	Exposure times			
	1/25	1/50	1/1000	1/250–1/1000
American types				
No. 6, No. 26	–	3	4	5
No. 31, No. 2 A	5	5	5	5
European types				
PF 24, S 2	–	3	4	5
PF 45	5	5	5	5

Numbers 6, 26, PF 24 and S 2 should not be used at 1/25.

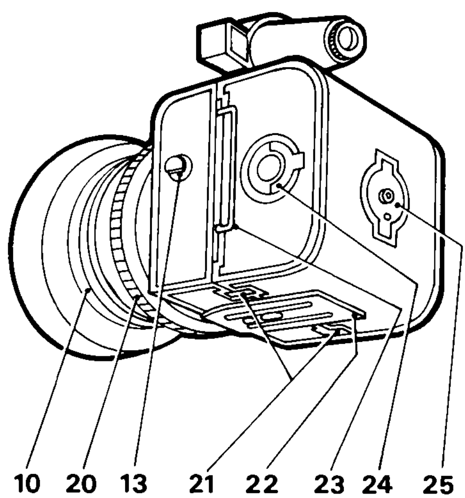
The original Superwide

The 38 mm Biogon was always the 'heart' of the Superwide. The original Superwide, however, was somewhat more like a view camera wide-angle lens

The old Superwide



1. Magazine loading key.
2. Film transport knob.
3. Magazine catch.
4. Wide-angle finder.
5. Depth of field scale.
6. Spirit level.
7. Distance scale on focusing mount.
8. Aperture lever.
9. Self-timer control.
10. Shutter speed ring.
11. Film counter of magazine.
12. Transport signals.
13. Fitting for neck strap.
14. Cable release socket.
15. Release button.
16. Synchronizing lever.
17. Flash socket.
18. Shutter tensioning lever.
19. Ultra-wide angle lens.
20. Focusing mount.
21. Hooks to hold magazine.
22. Base plate with tripod socket.
23. Handle of magazine slide.
24. Locking key of roll film holder.
25. Film indicator and window in magazine back.



attached to a Hasselblad roll film magazine. I say this because the operation of the camera was somewhat like that of a view camera lacking some of the automation that makes the present Superwide more like a 35 mm. The Biogon has two separate rings for aperture and shutter speed, like a view camera lens.

The camera's winding knob, not a winding crank, does nothing else but advance the film in the magazine. The Compur shutter in the lens has to be recocked separately with a lever, as on view camera lenses. Taking a picture therefore requires two operations. The shutter cocking lever is coupled to the self-timer control. For a self-timer exposure, pull the self-timer button (between the 250 and 500 engraving on the shutter speed scale) towards the camera, while at the same time tensioning the shutter. Pulling the cocking lever fully to the left, past the self-timer button, sets the self-timer delay and also cocks the shutter.

A PC flash contact is part of the lens, and flash pictures can be made at all shutter speeds from 1 to 1/500 sec plus B. A synchronizing lever with M and X positions is on the lens and must be set to X for electronic flash, to M for flash bulbs.

The release button at the front left of the camera is coupled to the film transport, which means that it cannot be depressed until the film has been advanced. Double exposures, therefore, are also made by removing the film magazine.

Most of the old Superwide cameras were delivered with an optical viewfinder as on the present cameras. You might find, however, some of the early models with a waist-level finder.

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Looking after your Camera

Keeping camera equipment in good working condition

Keeping the equipment clean is better than cleaning it. Keep all equipment away from dust and dirt whenever possible. Store each item in its case or box and keep these clean by vacuuming them frequently. When stored or carried without a lens or magazine, the inside of the camera is completely exposed so fit the protective covers on the lens mount and the back.

Blow dust from small crevices with compressed air using a small syringe or something similar. Take great care when dusting mirror, viewing screen or the bottom of the meter prism, but do not touch the titanium focal-plane shutter of the 2000FC. Never use canned air because it is usually very cold and results in condensation. Also the propellent agent may leave an oily residue. Cleaning the film magazines is most important. The exposure meter knob has a window in which dirt may accumulate. Blow, brush and wipe carefully.

Magazines for Polaroid film

The surfaces of the glass plate in the Polaroid film magazine are cleaned like lens surfaces. The developing mechanism under the magazine should be cleaned with a damp cloth after each film pack has been used as chemical residue tends to accumulate on the rollers.

Cleaning lenses

All anti-reflection coatings are relatively hard but can be scratched by grit, etc on the lens' surface. Before rubbing the surface of any lens with a tissue, blow away all loose particles of dust then use a soft brush like one of the special lens brushes which are available.

To remove a fingerprint, for example, breathe on the surface and quickly dry surface with a soft, clean lens tissue. Repeat this procedure a few times,

then check to see if the surface is thoroughly clean by breathing on it once again. If the fingerprint has gone, the condensation will form an even deposit without spots and will evaporate gradually and evenly. If the element is still dirty, repeat the process with a drop or two of lens cleaning fluid on a lens tissue. Never put the fluid directly on the lens as it may find its way into the lens mount. Use lens cleaning fluid sparingly.

Focusing screens

Should any screws retaining the focusing screens come loose, tighten them with a screwdriver of the proper size and shape to fill the slot completely. Put a tiny amount of clear nail polish under the head before tightening to safeguard against further loosening.

Fungus

When camera equipment is used in tropical climates or where humidity is high, clouding of glass surfaces, lenses, prisms, filters, etc often occurs. This is caused by a microscopically fine network of fungi attacking the polished surface by etching its pattern into the glass. Just removing the fungus does not solve the problem.

Fungi develops at humidities of 80% or more, but relative humidity decreases as the air temperature increases; therefore, humidity can be decreased by heating the air surrounding the camera equipment. For example, keep the camera in the sun, in circulating air; do not enclose it in an equipment bag or box without using a dessicant. Nutritive substances, grease, dust, can also help fungi to develop and should be removed from the equipment.

Humidity in small areas can be reduced with dessicants. Silica gel, usually in the form of small crystals in a dust-proof bag, is best for this purpose. Place the bag inside camera cases or containers which should be airtight. Choose indicator gel which changes colour from blue to pink when it reaches saturation point and needs regeneration. To regenerate, heat it at 120–150°C (250–300°F) for about 12 hours.

Optical surfaces covered with a slight film of fungus should not be cleaned with alcohol but with a special fungus cleaner. Such a cleaner, which is also a disinfectant, is made by Zeiss. It is applied with cotton, if necessary, repeatedly using a new piece of cotton each time. If fungus remains visible on the glass, return the equipment to the Hasselblad agent.

Low temperature photography

Humidity affects the camera's operation but it can perform at lower temperatures if the conditions are right.

The viscosity of lubricants increases (i.e. lubricants thicken) as the

temperature declines and consequently in cold weather, the camera mechanism operates more sluggishly and mechanical reaction time increases.

On Hasselblad, the lens shutters are the first affected with shutter speeds lengthening, e.g. $\frac{1}{4}$ sec becomes effectively $\frac{1}{2}$ sec, especially if the lubricant in the lens and shutter is old and dirty. You will get better shutter operation if the lenses and shutters have been cleaned and lubricated recently. Another suggestion is to operate all the shutter speeds a few times with the magazine removed which may get the lubricant 'working'. If the shutter speeds still appear too long, set the lens to a higher shutter speed.

Hasselblad cameras and lenses to be used in a very cold climate can be lubricated with special cold weather lubricants. Although this measure in itself is no guarantee against malfunctions, the use of special cold weather lubricants does reduce some risk factors. On return to normal conditions, it is imperative to relubricate the equipment with a standard lubricant, otherwise camera wear will be greatly accelerated since cold weather lubricants often have a low viscosity, are volatile and quickly work their way out of the mechanism at ordinary temperatures.

Simplify camera operation as much as possible. Remove any unnecessary accessories that cannot be operated with gloves, or add accessories that allow easier operation.

You may for instance normally work without quick focusing handles. Consider them, however, for cold weather; they make focusing with gloves easier. The release on camera grips is somewhat easier to operate than the release on the camera.

Pre-load film magazines before you go in the cold if possible. Make certain you have the groundglass screens you want to use in the camera. Changing screens is impossible without removing gloves.

Once you are out in the cold, avoid touching unpainted metal surfaces with ungloved hands, your face, your lips. The skin will stick to the metal. Don't breathe on lenses. The condensation will freeze, perhaps instantly, and is then very difficult to remove.

Condensation also occurs when cold equipment is brought into a warm room. This means that the chilled camera cannot be used indoors until its temperature equals that of the surroundings. A camera with condensation also cannot be taken out into the cold until the condensation has evaporated. If you do the condensation will freeze. This can be very serious as condensation may also cover the camera and lens mechanism inside and may 'freeze up' the entire camera and lens operation. Interior camera parts may also start to rust. It is possible to avoid this problem by placing the camera in an air-tight plastic bag and squeezing out the air before entering a heated room from the cold.

Extreme cold causes leather and rubber to become brittle. A wax leather dressing of good quality should be rubbed into carrying cases and leather-covered cameras to prevent the absorption of moisture. Rubber should be eliminated whenever possible.

All batteries lose their efficiency at low temperature and fresh batteries may become too weak after only a little use to operate the equipment. Always carry a spare set and keep them warm until they have to be used, e.g. in an internal pocket.

To avoid the effects of static electricity discharge with film and because it becomes brittle at very low temperatures, move the film slowly from frame to frame. Do not leave the film in the camera longer than necessary. It may dry out and break when it is used again. It is better to remove a partially exposed roll, and reload the magazine with a new roll when the camera is used again.

22

Unusual Light Sources

ULTRAVIOLET AND FLUORESCENCE PHOTOGRAPHY

Visible and invisible light

The light that is visible to the human eye has wavelengths from about 400 nm (violet) to about 700 nm (red). Beyond the red is radiation called infra-red, which is not visible to the eye but can be recorded photographically on special infra-red emulsions. At the other end of the spectrum, beyond the violet, is radiation called ultra-violet, which is also used in photography. The ultra-violet wavelengths are divided into three bands: long wave (320–400 nm), middle wave (280–320 nm) and short wave (ultra-violet 200–280 nm).

There are two distinctly different methods of using ultra-violet radiation in photography. In *ultra-violet photography* the subject is illuminated with ultra-violet light and photographed through a filter which absorbs all the visible light. It is used mainly in the scientific field for the examination of altered documents, engravings, tapestries, paintings, sculptures, etc. Other applications are in dermatology and photomicrography.

Normal photographic emulsions are sensitive far into the UV region (to approximately 250 nm) and the regular black-and-white roll-films can therefore be used for most UV photography. Colour films can also be used for UV photography but they offer no advantage over black-and-white as only the blue-sensitive layer reacts to the UV radiation. Black-and-white materials actually give better results.

Fluorescence photography means photographing objects and materials which fluoresce when subjected to UV light. The radiation from the subject has a longer wavelength than the UV light and therefore is visible to the human eye as the typical fluorescent colours. It offers great opportunities to produce colour slides with unusual and striking colours. The range of subjects that are fluorescent is almost unlimited. If the product does not fluoresce naturally, you can apply fluorescent paint.

The striking colour effects naturally call for colour film. Whether daylight or tungsten films are used is mainly based on personal preference. On daylight film, yellows and reds will be more brilliant; tungsten-light film will accentuate the blues and greens. Although the difference is small, base the choice of film on the fluorescing colour which is to be emphasized.

UV radiation sources

The selection of the light source must be based on the range of UV radiation that it supplies. The most frequently used sources are the so-called black-light tubes, or mercury lamps which are ideal for illuminating large areas. Fluorescent and mercury lamps emit mostly long wave ultra-violet radiation from 320 nm to 400 nm. Both types are available either in glass which emits visible and UV light (frequently marked BL) or in a specially filtered glass which absorbs practically all the visible light and transmits only the UV radiation. Only the latter (engraved BLB) should be used for fluorescence photography. The so-called germicidal lamps, which are low-pressure mercury tubes, are most commonly used when short-wave ultra-violet radiation (below 300 nm) is required.

Lenses

The light that reaches the camera in fluorescence photography is from the visible part of the spectrum. Therefore, the standard Hasselblad lenses from 30 mm to 500 mm can be used, if necessary in combination with close-up lenses and colour-compensating filters. Focusing is done in the normal fashion.

In ultra-violet photography, the choice of lens depends on whether the long or short range of ultra-violet radiation is used. The optical glass used in lenses transmits some ultra-violet light but only above wavelengths of approximately 350 nm. The normal camera lenses therefore can be used for ultra-violet photography in the long wavelengths.

For photographing in the shorter wavelengths, the Hasselblad 105 mm *f*4.3 UV Sonnar must be used. All elements are made from quartz which transmits UV radiation with wavelengths as short as approximately 215 nm. Obviously it makes no sense to use a quartz lens with accessories made from glass like Proxars that absorb the UV radiation. Use extension tubes or bellows for close-up photography.

There are no focusing and sharpness problems. Simply focus with visible light and then photograph by UV radiation without any adjustment in the distance setting. As the Sonnar also transmits visible light, the lens can be used for regular photography although it is usually advisable to use a haze filter on the lens to absorb the UV radiation.

Filters

In ultra-violet photography, only UV radiation must be permitted to reach the film. Thus the visible light must be absorbed with a filter over the camera lens. Excellent filters, for work in the long wave UV region are the Wratten 18A or the Schott UG11. The latter, in a bayonet mount to fit the UV Sonnar, is supplied with each lens.

These filters are used with all UV radiation sources (blacklights, daylight, flash). Since they transmit only light with wavelengths about 320 nm, they are obviously not suitable for medium and short wave UV photography where the quartz lens has its greatest value. Filters for medium and short wave ultra-violet transmittance are usually of the interference type and are available from firms specializing in this field.

In fluorescence work, the opposite applies. Only light from the visible part of the spectrum is to be recorded on the film. So a UV-absorbing filter (such as Wratten No. 2A or 2B), which absorbs all radiation below 400 nm but does not fluoresce, is placed over the lens. If this filter is not available, you can try an R-12 (85) or the yellow filter made for black-and-white photographs.

Exposure

In fluorescence work you can base exposure on the reading obtained from a sensitive reflecting exposure meter. The reading must be made through the filter that will be used on the camera lens (2A, 2B, 85, yellow). As light levels are low, only the most sensitive meters will give a reading. Exposures will be around $\frac{1}{8}$ sec at *f*2.8, with a good size backlight tube (48 in) about 60 cm (24 in) from the subject.

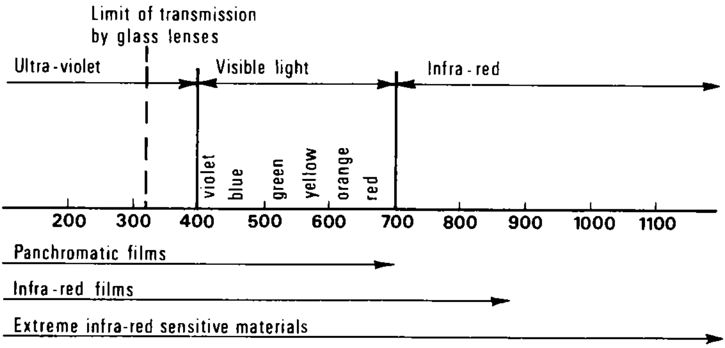
In ultra-violet work ordinary exposure meters are usually unsuitable as their light sensitivity in the UV spectral range is limited. Special meters made for the UV spectral range are available. Otherwise, test exposures are most reliable. Start with an exposure three to seven stops larger than that indicated by a meter.

Another method as a starting point is to place a UG11 or 18A filter over the photoelectric cell of the exposure meter and set the film speed (ASA) at a figure that is a tenth of the daylight value of the film being used. Use the reading indicated on the meter.

To compensate for reciprocity failure, double exposure times when they exceed 9 sec.

INFRA-RED PHOTOGRAPHY

Infra-red radiation, which is the invisible radiation with wavelengths beyond 700 nm, has very important applications in scientific photography and exciting possibilities for the experimenting photographer to produce images



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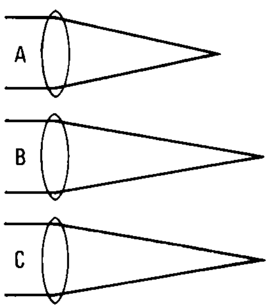

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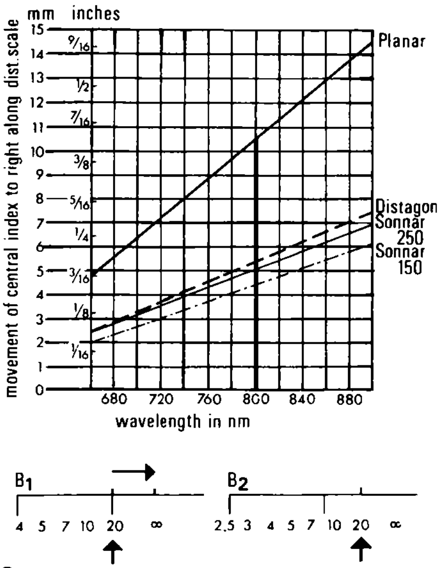

3.

Part of the electromagnetic spectrum used in photography
The visible light extends from 400 nm to 700 nm; infra-red radiation has wavelengths above this and ultra-violet wavelengths below. Panchromatic emulsions record radiation up to about 730 nm, infra-red films up to about 880 nm and extreme infra-red materials beyond 1000 nm. Ultra-violet light, at the other end of the spectrum is recorded on regular emulsions. Glass transmits radiation down to about 320 nm.

2 Infra-red radiation (B) forms an image further from the lens than the visible light (A). The image on the filmplane is therefore out of focus unless you compensate for this by moving the lens forward (C).

3 Infra-red focusing correction chart. The infrared wavelength range is an horizontal axis. The vertical axis shows in millimetres and inches how much the focusing ring on the lens must be changed. For example, with an infra-red film sensitive to 850 nm and a filter that absorbs all the light under 800 nm, move up the 800 vertical line until you reach the diagonal that corresponds to the lens, then move across to the left to find the displacement. With the 80 mm Planar, this is 10 mm ($\frac{3}{8}$ in). Mark the infra-red red index on the lens 10 mm to the right from the normal index (B_1) and set distance opposite new index (B_2).

with unusual colours or tonal renditions on black-and-white film. For most photographic purposes, wavelengths from 700 to about 900 nm are used.

Practically all light sources used in photography—daylight, Tungsten lights, electronic flash—contain infra-red and can therefore be used for infra-red work. Regular black-and-white and colour films on the other hand are not sensitive to infra-red and therefore unusable. Special infra-red films must be used for infra-red photography. Such films are available in 70 mm and sheet film for use in Hasselblad. The magazine 70 has a pressure plate that does not reflect infra-red which is important for best infra-red image quality and contrast.

Lenses and focusing

All photographic lenses transmit infra-red radiation and are therefore usable. The lenses, however, are corrected only for the visible range of light and therefore only these wavelengths are focused on the filmplane. Infra-red with its longer wavelengths forms the image behind the filmplane.

With colour film, this shift of focus presents no problem because the image is not formed by infra-red only but by infra-red, green and red with the latter two predominating.

Images on infra-red-sensitive back-and-white film on the other hand will be out of focus at the filmplane. The image you see and focus on the ground glass is the image created by the visible light—not the infra-red image. For long distance shots, at *f* 11 or smaller, depth of focus may take care of the discrepancy.

In close-up photography and when using larger apertures a focus adjustment must be made that amounts to about $\frac{1}{200}$ of the lens' focal length.

The adjustment necessary on the Planar, Distagon and Sonnar lenses can be determined from the chart on p. 243. The distance you read off the chart is the distance the focusing ring must be turned, not the change in the lens-to-filmplane distance. The distance is measured from the central index mark on the lens to the right. Make a grease pencil mark at that point. This is your infra-red index. Focus the image with the usual accuracy on the ground glass. Read off the distance opposite the original central index. Let's say it is 5 m. Now turn the focusing ring until the distance (5 m) is opposite the infra-red index. The lens is then focused for infra-red radiation.

The 250 mm Sonnar Superachromat is chromatically corrected not only for the visible light but also for infra-red radiation up to 1000 nm. The infra-red image is formed at the same plane as normal wavelengths and a focus adjustment is not necessary. You do not need the usual deep red filter that darkens the image drastically. Place the filter over the lens afterwards and be assured of sharp image even with the aperture at *f* 5.6. As the images of all colours are formed in the same plane, the image quality in infra-red work and in ordinary black-and-white photography with red filters is also improved.

Colour infra-red photography

Colour infra-red photography has wide application in aerial surveying, medical and biological photography but is also an exciting medium for the experimenting photographer. Exposures are usually made through orange filters and the manufacturers usually indicate the film sensitivity when combined with such a filter. For experimenting, other filters—red, green, blue, violet, yellow—can be used. Each produces different colour arrangements.

All infra-red films should be stored at 13°C (55°F) in the original sealed container. Remove them 2 hours before use from a refrigerator or 6 hours from a freezer. Process the film as quickly as possible after exposure or store below 4°C (40°F).

Infra-red films must be processed or loaded in total darkness.

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Page numbers in italic refer to illustrations.

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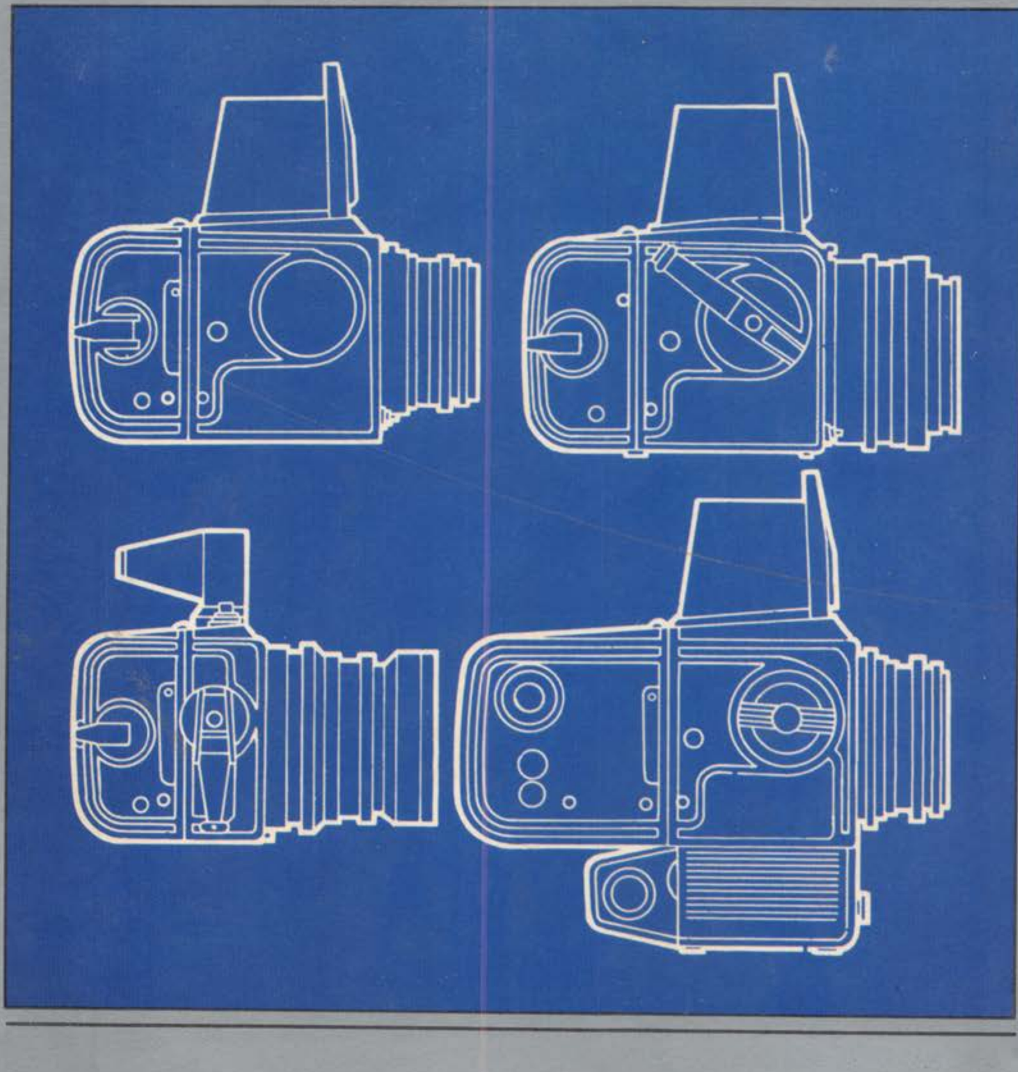

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The HASSELBLAD Manual